

6. ORTHOPEDIC INJURIES
B. Mangled Extremity

OBJECTIVE: To define the diagnosis, prognosis, and management of a “mangled” extremity.

Guidelines: A “mangled extremity” is defined as a combination of vascular, bony, soft tissue, and/or nerve injury jeopardizes the viability of the limb. Mangled extremities include Gustilo III B or III C injuries. When considering limb preservation vs amputation, amputation should seriously be considered as a potentially better alternative. This is especially true when the risk of systemic complications is high or when the salvaged limb will be less functional than prosthesis. Despite the availability of many predictive models, the estimation of successful limb salvage in terms of patient morbidity and long-term limb function has been limited by the lack of class I data. Additionally, all the scoring systems are based on only data from lower extremity injuries. Johansen et al.¹ proposed the use of the Mangled Extremity Severity Score (MESS). This includes four primary risk elements:

1. Soft tissue injury
2. Limb Ischemia
3. Shock
4. Patient Age

With this model, a score ≥ 7 was 100% predictive of amputation. A subsequent study by McNamara et al. used nerve injury, ischemia, soft tissue injury, skeletal injury, shock, and the patient's age (NISSA) score to predict the need for amputation². *However, all scoring systems have not been validated in larger prospective studies.*

**Mangled Extremity Severity Score
(MESS)**

			Score
Limb Ischemia for > 6 hours		No = 0 Yes = 1	
Limb Ischemia	Reduced Pulse but normal perfusion	+1	
	Pulseless; paresthesias, slow capillary refill	+2	
	Cool, paralyzed, numb/insensate	+3	
Patient Age	< 30 yrs.	0	
	30 – 50 yrs.	+1	
	≥ 50 yrs.	+2	
Shock	SBP > 90 mm/ Hg	0	
	Transient Hypotension	+1	
	Persistent Hypotension	+2	
Mechanism	Low Energy: Stab, Pistol GSW, Simple Fracture	+1	
	Medium Energy: Dislocation, Open or Multiple Fractures	+2	
	High Energy: High-Speed MVA, Rifle GSW	+3	
	Very High Energy: High-speed trauma with gross contamination	+4	

Total

Predictive of Limb Salvage ≤ 6
Low Likelihood of Limb Salvage ≥ 7

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DIAGNOSIS AND MANAGEMENT:

Stop the Bleeding:

The initial evaluation of a patient with a mangled extremity does not differ from any other patient with multiple injuries. The [ABCs](#) take precedence; the only immediate life-threatening aspect of a mangled extremity is external blood loss that must be controlled. As part of the primary survey, attention must be directed at controlling active bleeding from a mangled extremity. Direct control of the bleeding should be obtained either by manual pressure. If manual pressure fails to control the bleeding, then a proximal tourniquet can be used. It is important to apply appropriate inflation pressure above systolic blood pressure. This helps to avoid a venous tourniquet effect, allowing continued arterial bleeding and compromised venous outflow. If the bleeding cannot be controlled by these two maneuvers, or if the patient remains hemodynamically unstable, the patient must be taken to the operating room for emergent exploration and vascular control. If the tourniquet cannot be removed within an hour, this is another indication to take the patient to the operating room.

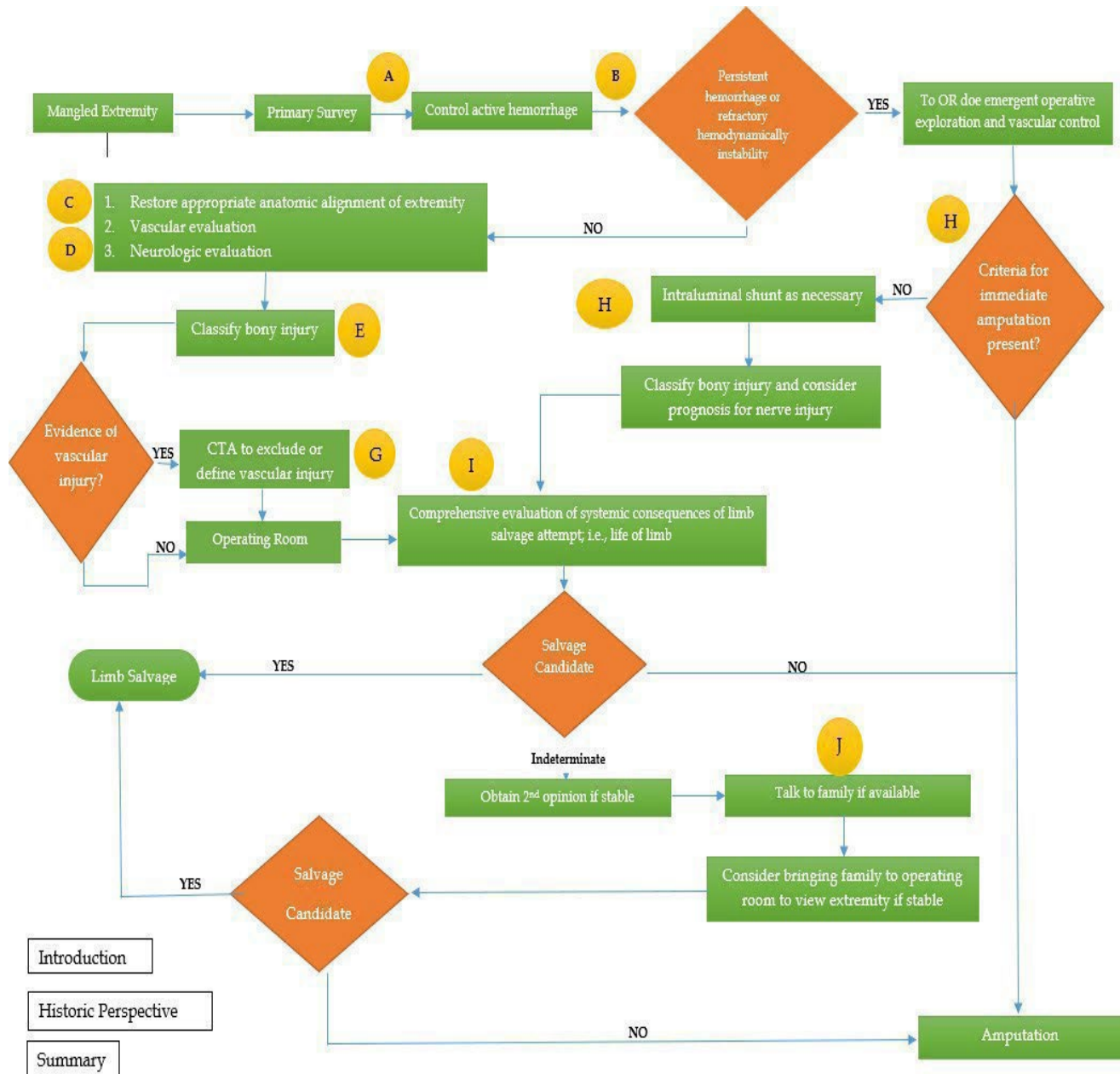
If there is no active bleeding, evaluate for vascular injury or compromise:

The first priority is to restore the anatomic alignment of the extremity and try to identify a pulse. If a pulse cannot be identified, the next step would be to proceed with a Doppler assessment. If the pulse in the injured extremity is perceived to be not equal to the pulse on the uninjured side, if possible, obtain an Ankle-Brachial Index (ABI) or Brachial-Brachial index (BBI). An ABI or BBI of less than 0.9 requires further operative or radiographic investigation. It's important to keep in mind that both the ABI and BBI can be affected by a variety of factors, which include obesity, hypotension, hypothermia, hemorrhage, and chronic vascular disease. Additionally, an inappropriate cuff size may affect the ABI and TBI indices as well. The patient must be warm to improve the reliability of these Doppler indices. If there was a concern for vascular injury, the patient should undergo a CTA of the extremity when the patient has been stabilized.

Amputation:

Sometimes, based on the magnitude of the injuries sustained, the decision to amputate can be simple. If the patient can be stabilized, decision to amputate should be made with the input from the consulting physicians from other services. If possible, the decision should be made by at least two Attending Surgeons from different services.

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Introduction

Historic Perspective

Summary

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TABLE 4. Peripheral Nerve Injury Findings

Lower extremity

Femoral nerve

Motor: inability to extend the lower extremity at the knee

Sensory: numbness over distal 1/3 of the anteromedial aspect of the thigh

Peroneal nerve injury

Motor:

Common peroneal: weakness or inability to dorsiflex foot and toes, as well as foot eversion ("foot drop")

Deep peroneal: weakness or inability to dorsiflex foot and toes

Superficial peroneal: inability to evert foot

Sensory:

Deep peroneal: decreased or absent sensation dorsal web space between 1st and second toes

Superficial peroneal: decreased or absent sensation remainder of dorsal foot

Tibial nerve injury

Motor: weakness or absence of toe plantar-flexion or foot inversion (foot plantar flexion by Achilles-gastroc-soleus)

Sensory: numbness over sole and heel of the foot

Upper extremity

Median nerve

Motor: weak or absent flexion of thumb and index finger IP joints against resistance

Sensory: decreased or absent sensation palmar surface of thumb, index and middle fingers

Radial nerve

Motor: weak or absent dorsiflexion of wrist and/or thumb

Sensory: decreased or absent sensation in dorsal web space between thumb and index fingers

Ulnar nerve

Motor: weakness or absence of finger abduction and adduction

Sensory: decreased or absent sensation little finger and ulnar half of ring finger

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References:

1. Johansen K et al. Objective criteria accurately predict amputation following lower extremity trauma. J Trauma. 30:568 -572; discussion 572-573, 1990
2. McNamara MG et al. Severe open fractures of the lower extremity: A retrospective evaluation of the Mangled Extremity Severity Score (MESS). J Orthop Trauma. 8:81- 87, 1994
3. Russell WL et al. Limb salvage versus traumatic amputation. A decision based on a seven-part predictive index. Ann Surg. 213:473-81, 1991
4. Suedkamp NP et al. The incidence of osteitis in open fractures: an analysis of 948 open fractures (a review of the Hannover experience). J Orthop Trauma. 7:473-82, 1993.
5. Bosse MJ et al. A prospective evaluation of the clinical utility of the lower-extremity injury-severity scores. J Bone Joint Surg Am. 83-A:3-14, 2001

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