Simulation Scenario Template

Section 1: Case Summary

Scenario Title:	Neurogenic Shock
Keywords:	Shock, Respiratory Failure
Brief Description of Case:	64 yo F with C4 ASIA A spinal cord injury and fluid refractory distributive shock

Goals and Objectives	
Educational Goal:	To practice team leading in trauma and spine injury
Objectives: (Medical and CRM)	-General approach to neurogenic shock -Approach to fluid resistant distributive shock -Recognition and management of cervical spinal cord injury and complications including respiratory failure
EPAs Assessed:	

Learners, Setting and Personnel				
Target Learners:	☐ Junior Learners	☒ Senior Learners	☐ Staff	
	☒ Physicians	☐ Nurses	☐ RTs	☐ Inter-professional
	☐ Other Learners:			
Location:	☐ Sim Lab	☐ In Situ	☐ Other:	
Recommended Number of Facilitators:	Instructors: 1			
	Sim Actors:			
	Sim Techs: 1			

Scenario Development	
Date of Development:	May 2023
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Last Revision Date:	
Revised By:	
Version Number:	

Section 2A: Initial Patient Information

A. Patient Chart					
Patient Name: Roberta Edmundson			Age:64	Gender: F	Weight: 70kg
Presenting complaint: Neck Trauma, Low Risk Mechanism					
Temp: 36.7	HR: 67	BP: 130/90	RR: 18	O_2Sat: 97%	FiO_2: N/A
Cap glucose: 5.2			GCS: 15		
You're working at an overcrowded community hospital with no surgical capabilities. Patient seen in hallway, language barrier. Triage note: numbness and no sensation to bilateral lower legs.					
Allergies: NSAIDs					
Past Medical History: • Hypertension • Dyslipidemia • Diffuse Idiopathic Skeletal Hyperostosis (DISH)			Current Medications: • Atorvastatin 20mg po daily • Pantoprazole 40mg po daily • Valsartan 160mg • Hydrochlorothiazide 25mg po daily		

Section 2B: Extra Patient Information

A. Further History
Include any relevant history not included in triage note above. What information will only be given to learners if they ask? Who will provide this information (mannequin's voice, sim actors, SP, etc.)? • ED report: yesterday presented after falling from a 2 foot step stool and hitting the back of her head on a metal cupboard handle. Complaining of 10/10 midline neck, hand numbness and back pain with EHS. CT head C spine normal, evidence of DISH, outpatient follow up arranged. • EHS report today: Patient developed worsening numbness and weakness in her legs and arms with urinary retention. Assisted by family members to ED for progression of symptoms.

B. Physical Exam	
List any pertinent positive and negative findings	
Cardio: N S1/S2, no murmurs	Neuro: CN normal
Resp: GAEB, no crackles, no wheeze	Head & Neck: Tender midline C spine
Abdo: soft, non tender	MSK/skin: no bruises or abrasions, not moving limbs
Other neuro: Patient lying supine on a hard board with hard collar. Intact sensation to light touch in C4 bilaterally, decreased to ½ to light touch in C5 bilaterally, absent from C6 down to T1, and absent in all the thoracic dermatomes as well as in L1 down to S1. Motor function absent in lower extremities. In upper extremities, she can do shoulder shrug with no good resistance. Active full ROM with elbow flexion but does not resist at all (3/5 strength in C5 dermatome). 0/5 motor function in C6, C7, C8 and T1 bilaterally. Deep tendon reflexes absent in upper and lower extremities, no Hoffman reflex, no ankle clonus, no reaction to Babinski reflex. Rectal exam reveals no sensation to light touch with no sharp sensation. She has flaccid rectal tone and no voluntary contraction. No anal wink. Weak bulbocavernosus reflex with pulling of the Foley catheter.	

Section 3: Technical Requirements/Room Vision

A. Patient
☒ Mannequin *(specify type and whether infant/child/adult)*
☐ Standardized Patient
☐ Task Trainer
☐ Hybrid
B. Special Equipment Required
Apply C Spine Collar Consider Vista Collar in room for teaching purposes
C. Required Medications
Norepinephrine, IV fluids
D. Moulage
N/A
E. Monitors at Case Onset
☐ Patient on monitor with vitals displayed ☒ Patient not yet on monitor
F. Patient Reactions and Exam
Include any relevant physical exam findings that require mannequin programming or cues from patient (e.g. – abnormal breath sounds, moaning when RUQ palpated, etc.) May be helpful to frame in ABCDE format. A- normal B- normal C- normal D- no arm or leg movement except shoulder shrug and elbow flexion E- no visible injuries

Section 4: Scenario Progression

Scenario States, Modifiers and Triggers				
Patient State/Vitals	Patient Status	Learner Actions, Modifiers & Triggers to Move to Next State		Facilitator Notes
1. Baseline State Rhythm: sinus HR: 67 BP: 130/90 RR: 18 O_2SAT: 97% T: 36.7 °C GCS: 15 PVR: 500cc	*Is the patient alert? In distress? Seizing? What symptoms do they currently have?* Patient alert and oriented	Expected Learner Actions ☐ Initial ABCs ☐ Identify concern with D ☐ Complete E with log roll ☐ Consider FAST ☐ Move on to secondary survey ☐ Identify significant neuro deficit ☐ Insert foley catheter	Modifiers *Changes to patient condition based on learner action* Triggers *For progression to next state* -Consult Neuro -Suggest MRI/repeat imaging	Physical exam should be looking for level of C spine injury and need bulbocavernosus reflex to determine if spinal shock present Quick trauma assessment, move forward by stating all is normal Once imaging/Neuro consult done, indicate patient going for urgent MRI
2. Repeat Vitals, at MRI HR: 38 SBP: 90 RR: 18 O_2SAT: 97% T: 36.6 °C GCS: 14	Patient confused	Expected Learner Actions ☐ Start IV + fluid bolus ☐ Request ECG + gluc ☐ Start pressors(norepi) ☐ Send trauma labs (if not done) ☐ State need to rule out hemorrhagic shock ☐ Consider targeting goal MAP >80mmHg in isolated spinal cord injury	Modifiers -if no pressors started, continue to drop BP Triggers -Start vasopressors (norepi)	MRI demonstrates anterolisthesis of C5 on C6, with bilateral facet lock. Fracture through the ossified anterior longitudinal ligament and the C5-6 disc, continuing posteriorly through the C5-6 facet joint capsules, marked cord compression at C5-6.
3. Repeat Vitals, awaiting transfer HR: 50 SBP: 120/80 RR: 22 O_2SAT: 95% T: 36.5 °C	GCS 15, Mild cough with difficulty clearing secretions	Expected Learner Actions ☐ Identify future need to secure airway ☐ Spine surgery consult ☐ Continue C spine precautions/consider Aspen	Modifiers - Triggers -3 minutes of time elapse	Spine Surgery consulted ASIA A at C5 Start transfer call Give bloodwork indicating respiratory acidosis from patient fatigue

GCS: 15		☐ Identify bradycardia may require external pacing or atropine ☐ Plan for transfer		
4. Repeat Vitals HR: 55 SBP: 125/75 RR: 30 O_2SAT: 96% NP T: 36.0 ^oC GCS: 15	Tachypnea with mild increased work of breathing	Expected Learner Actions ☐ Recognize impending respiratory failure ☐ Rapid-sequence intubation with in-line spinal immobilization ☐ Apply bair hugger ☐ Consult ICU ☐ Continue with transfer to definitive care	Modifiers - Bradycardia to PEA arrest if no action taken to correct breathing Triggers -Intubation complete, end the case	Impending respiratory failure, such as increased respiratory rate, declining forced vital capacity (FVC) with RT at bedside, rising pCO_2, or falling pO_2, indicate urgent intubation and ventilation with positive pressure support. Intubation before transfer

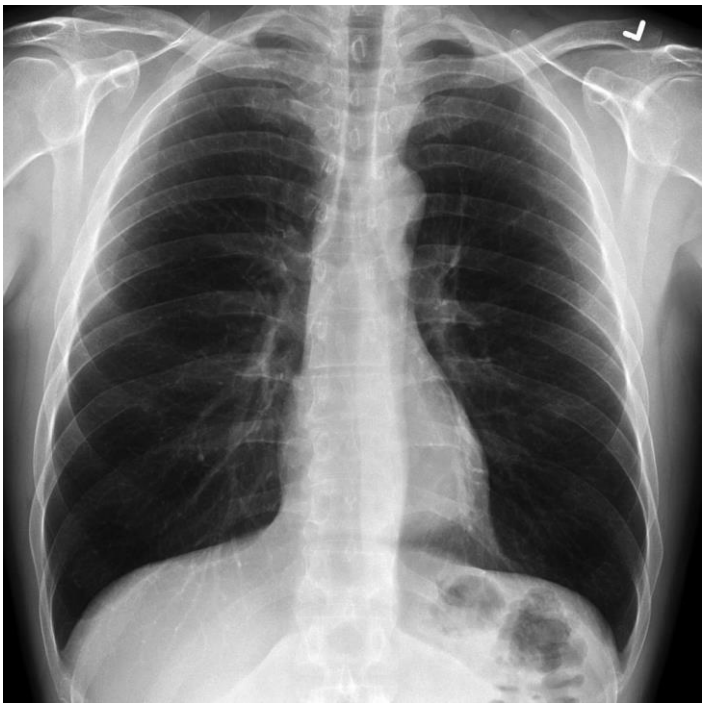
Appendix A: Laboratory Results

CBC WBC 8 Hgb 125 Plt 250 Lytes Na 135 K 4 Cl 100 HCO_3 24 Urea 10 Cr 150 Glucose 6 Cardiac/Coags INR 1 aPTT 22	VBG 1 pH 7.4 pCO_2 40 HCO_3 24 Lactate 1 VBG 2 pH 7.3 pCO_2 55 HCO_3 25.5 Lactate 3 VBG 3 pH 7.1 pCO_2 70 HCO_3 28 Lactate 3.5

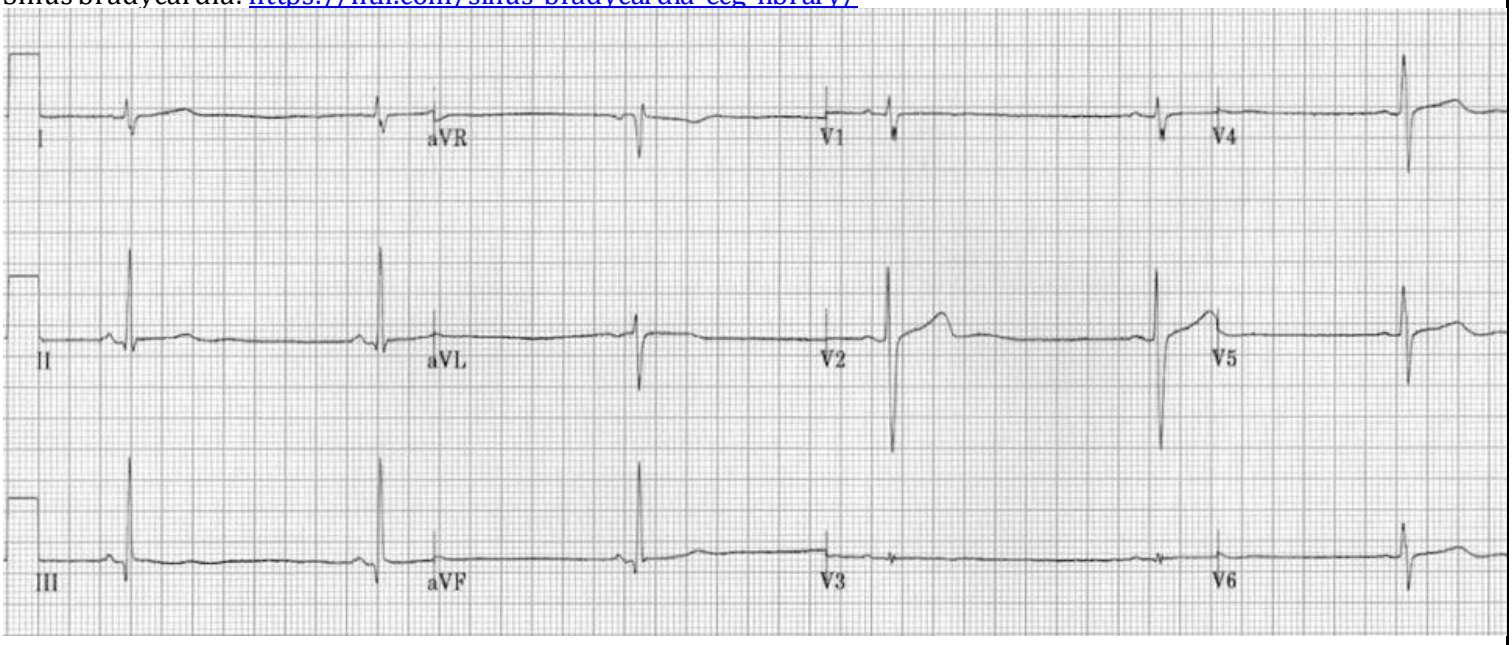
Appendix B: ECGs, X-rays, Ultrasounds and Pictures

Paste in any auxiliary files required for running the session. Don't forget to include their source so you can find them later!

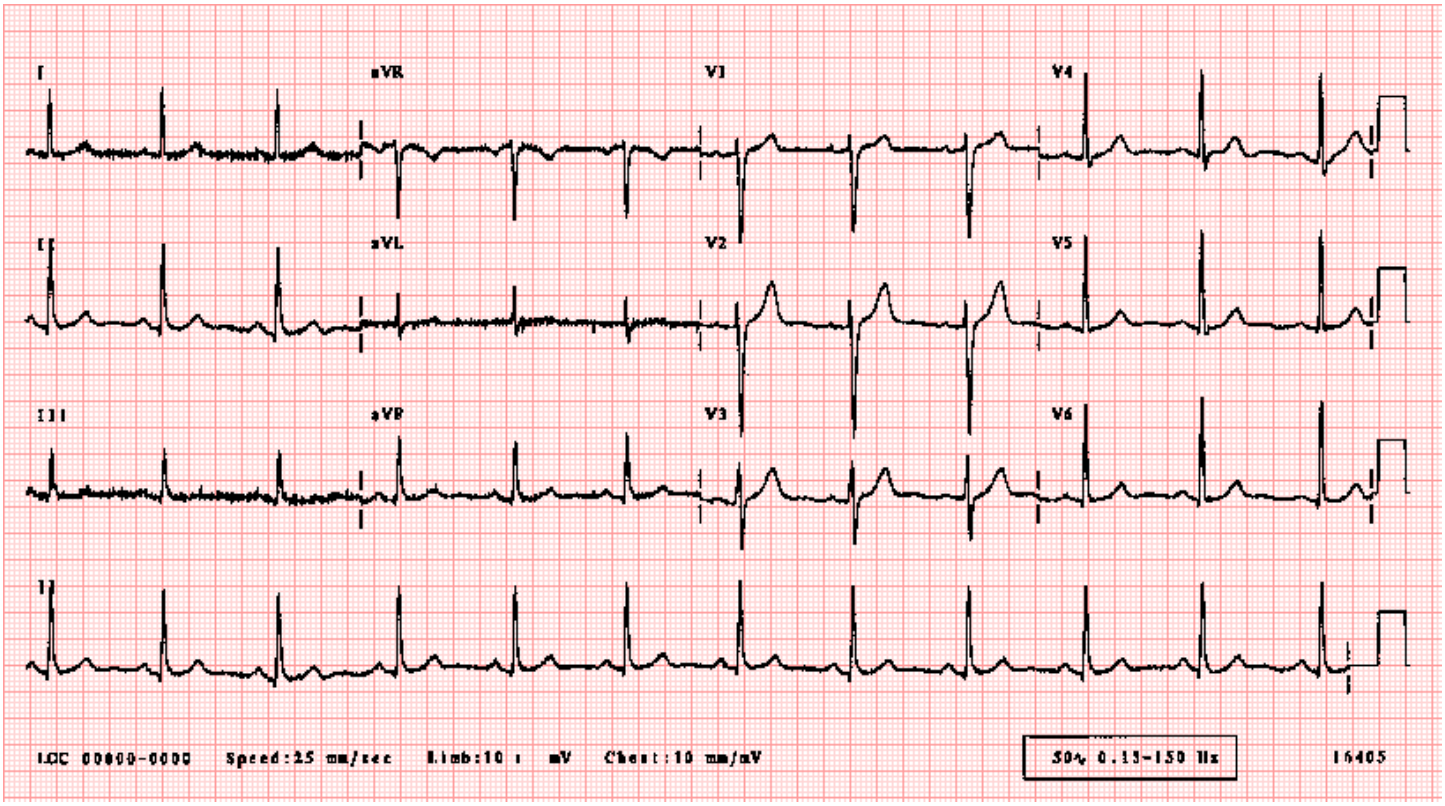
Normal CXR: https://radiopaedia.org/cases/normal-chest-x-ray



Sinus bradycardia: https://litfl.com/sinus-bradycardia-ecg-library/



Normal ECG: https://ecglibrary.com/norm.php



Appendix C: Facilitator Cheat Sheet & Debriefing Tips

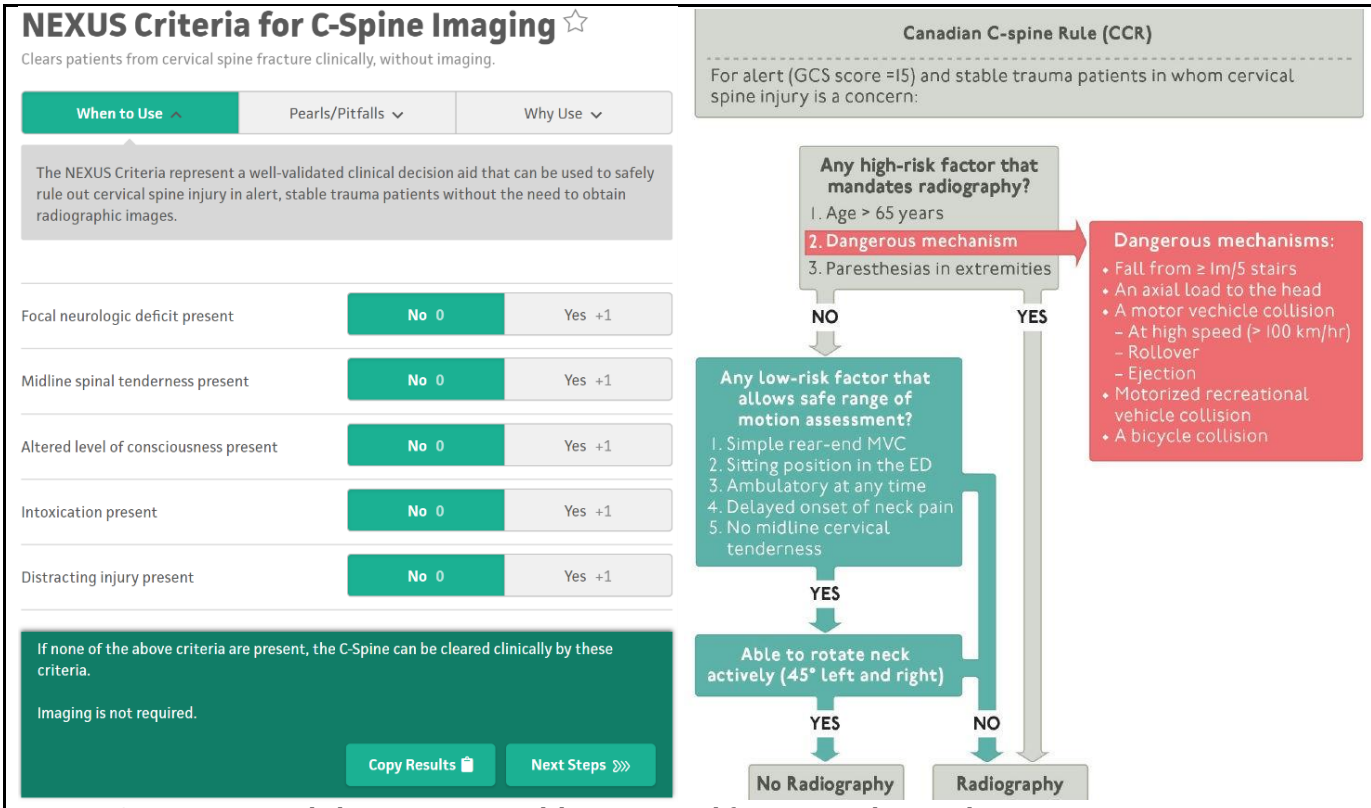
Include key errors to watch for and common challenges with the case. List issues expected to be part of the debriefing discussion. Supplemental information regarding any relevant pathophysiology, guidelines, or management information that may be reviewed during debriefing should be provided for facilitators to have as a reference.

- **Spinal Shock:** temporary loss or depression of spinal reflex activity that occurs below a complete or incomplete spinal cord injury; presents with flaccidity, loss of reflexes and loss of voluntary movement.
  - Can cause incomplete injury to mimic complete injury.
  - Delayed plantar and bulbocavernosus reflex are among the first to return as spinal shock resolves.
  - Lasts days to weeks, can persist for 6 months
- **Neurogenic Shock:** Distributive shock that occurs with CNS or spinal cord injury. <20% of of spinal-cord injured patients, loss of peripheral sympathetic innervation resulting in extreme vasodilation secondary to loss of sympathetic arterial tone causing hypotension with relative bradycardia.
  - Consider CVC for transfer if concern for neurogenic shock.
  - May also have excessive heat loss and hypothermia

Adequate blood pressure is believed to be critical in maintaining adequate perfusion to the injured spinal cord and thereby limiting secondary ischemic injury. Consider targeting goal MAP >80mmHg in isolated spinal cord injury
Autonomic dysreflexia is usually a later complication of spinal cord injury but may appear in the hospital setting, requiring acute management. This phenomenon is characterized by episodic paroxysmal hypertension with headache, bradycardia, flushing, and sweating.

DISH review:

- Noninflammatory disorder principally characterized by calcification and ossification of spinal ligaments and entheses.
- Diffuse idiopathic skeletal hyperostosis (DISH) is more common in males than females. The incidence varies by population and increases with age, rarely being diagnosed before the age of 40. The cause remains unknown.
- Patients with DISH may experience musculoskeletal pain and stiffness in affected areas, including the neck, back, and sometimes the extremities; experience reduced spinal motion, especially in the thoracic spine (which is present in all patients in advanced cases); and demonstrate characteristic radiographic changes, including ossification of paravertebral ligaments and peripheral entheses.
- Neurologic complaints or findings may occur due to ossification of the posterior longitudinal ligament (OPLL), which can result in spinal cord compression and may lead to sensory or motor disturbances due to myelopathy. OPLL can cause cervical myelopathy with potentially devastating neurologic complications, including quadriparesis and quadriplegia.
- Symptoms that should raise concerns for the development of cervical myelopathy include the development of sharp, shooting pain in the neck; the sudden loss of cervical spine motion; the presence of an unsteady gait and brisk reflexes; and the development of new sensory symptoms in the extremities.



- CT is recommended as primary initial diagnostic tool for suspected cervical spine injury
- MRI is imaging modality of choice if a ligamentous or spinal cord injury is strongly suspected (ie symptomatic patients with negative CT with persistent neurologic deficits or positive CT)
- CTA in blunt cerebral vascular injury. Cervical spine fractures are risk factors for carotid or vertebral artery dissection. Many patients are initially asymptomatic and diagnosis can be delayed for days until neuro sx become evident.

Screening Criteria for Blunt Cerebral Vascular Injury

Signs and symptoms

- Arterial hemorrhage from nose, neck, or mouth
- Cervical bruit in patients <50 y old
- Expanding cervical hematoma
- Focal neurologic deficit: transient ischemic attack, hemiparesis, vertebrobasilar symptoms, Horner's syndrome
- Stroke on secondary CT
- Neurologic deficit unexplained by head CT

Risk factors for blunt cerebral vascular injury

- High-energy transfer mechanism and one of the following:
  - Facial fractures: Le Fort II or III fracture, mandible fracture, frontal skull fracture, orbital fracture
  - Cervical spine fracture patterns: subluxation, fractures extending into the transverse foramen, fracture at any level
  - Any basilar skull fracture or occipital condyle fracture
  - Petrous bone fracture
  - Diffuse axonal injury with Glasgow Coma Scale score ≤8
  - Concurrent traumatic brain and thoracic injuries
  - Neck hanging with anoxic brain injury
  - Clothesline type injury or seat belt injury with significant swelling, pain, or altered mental status
  - Scalp degloving
  - Thoracic vascular injuries
  - Blunt cardiac rupture
  - Upper rib fractures

*High energy transfer mechanism= cervical hyperextension and rotation, hyperflexion, or direct blow

American Spinal Injury Association (ASIA) Impairment Scale

ASIA Impairment Scale (AIS)

A = Complete. No sensory or motor function is preserved in the sacral segments S4-5.

B = Sensory Incomplete. Sensory but not motor function is preserved below the neurological level and includes the sacral segments S4-5 (light touch or pin prick at S4-5 or deep anal pressure) AND no motor function is preserved more than three levels below the motor level on either side of the body.

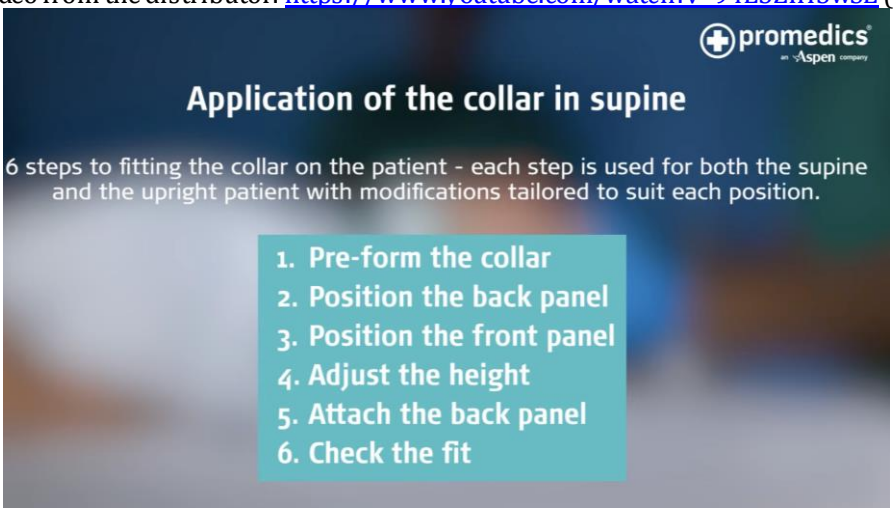
C = Motor Incomplete. Motor function is preserved at the most caudal sacral segments for voluntary anal contraction (VAC) OR the patient meets the criteria for sensory incomplete status (sensory function preserved at the most caudal sacral segments S4-5 by LT, PP or DAP), and has some sparing of motor function more than three levels below the ipsilateral motor level on either side of the body. (This includes key or non-key muscle functions to determine motor incomplete status.) For AIS C – less than half of key muscle functions below the single NLI have a muscle grade ≥ 3.

D = Motor Incomplete. Motor incomplete status as defined above, with at least half (half or more) of key muscle functions below the single NLI having a muscle grade ≥ 3.

E = Normal. If sensation and motor function as tested with the ISNCSCI are graded as normal in all segments, and the patient had prior deficits, then the AIS grade is E. Someone without an initial SCI does not receive an AIS grade.

Using ND: To document the sensory, motor and NLI levels, the ASIA Impairment Scale grade, and/or the zone of partial preservation (ZPP) when they are unable to be determined based on the examination results.

Aspen collars, official video from the distributor. https://www.youtube.com/watch?v=94E3ZIH3wSE (19 minute video)



1. Bending or rolling collar ends in towards the centre
2. Person performing head hold from head of the bed, second person positions back panel next to head between ear lobes and trapezius muscle, vista should read right side up to person placing. Compress bedding and slide behind neck. Velcro strap should be midpoint between bottom of earlobe and top of trapezius
3. Hold front section firmly in place and push side panels up over the shoulders, around neck towards the ears
Chin should be centred on chin piece and aligned with dial and sternal notch
4. Pull dial out to release lock and maintain pull to turn clockwise and raise front section or counterclockwise to lower front section chin piece. Dial up until foam begins to compress. Release dial and auto locks
No gap between chin and chin piece
5. Velcro straps one side at a time and should be symmetric
6. Collar flush with skin, check by pushing finger down past the ear, behind the mandible, run finger along collar toward the chin and under sternal aspect.

Intubation:

- The higher the level of the spine injury, the more likely is the need for airway intervention.
- Unstable spine lesions above C3 can cause immediate respiratory arrest.
- Lesions affecting C3-C5 can affect the phrenic nerve and diaphragm function.
- Some experts recommend any patient with an injury at C5 or above should have the airway secured by endotracheal intubation.
- Delayed respiratory compromise can also occur if spinal cord edema from more caudal lesions progresses rostrally to cause phrenic nerve paralysis.
- Maintain manual in-line spinal stabilization while intubating.

Signs of impending respiratory failure, such as increased respiratory rate, declining forced vital capacity (FVC) with RT at bedside, rising pCO_2, or falling pO_2, indicate urgent intubation and ventilation with positive pressure support.

Injury at C6 through C8 — Patients with complete cervical SCI but with intact diaphragm function are able to inhale via the diaphragm and accessory muscles above the level of injury (such as muscles in the neck). Exhalation occurs primarily through the passive recoil of the chest wall and lungs, because the primary muscles of exhalation (internal intercostals and muscles of the abdominal wall) are paralyzed. When the arms are fixed, the clavicular portions of the pectoralis major muscles may contribute to exhalation; training of this muscle has been described but typically provides only a small contribution. Thus, cough is impaired and even if these patients do not have initial respiratory failure, they are at an increased risk of respiratory muscle fatigue in the setting of respiratory system loading (eg, pneumonia or excess secretions)

References

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