Managing Neurostorming in a Patient with Severe Brain Injury

MANAGEMENT, TREATMENT OR SO WE THINK!

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Many Names-1 Lived Experience

- Sympathetic Storm
- Paroxysmal Sympathetic Hyperactivity (PSH)
- Autonomic Dysautonoma Syndrome
- Acute Midbrain Disorder
- Autonomic Storms
- Storming
- Neurastorming
- Dysautonemia

Who is at risk?

https://www.youtube.com/watch?v=FhN_ecptyGc

Who is at risk?

Men
65 or older
0-4 years of age
Who is at risk?

65 or older......

Fall

Who is at risk?

Age 5-24......
Who is at risk?

Age 5-24......

MVC

Who is at risk?

Age 0-4......

Who is at risk?

Age 0-4......

Assault
What's the Big Deal?[1]

- 2.5 million ED visits annually
- Over the past decade... TBI ED visits increased by 70%,
hospitalization rates increased by 11%, death rates decreased by 7%
- 40% of TBI's occur from falls
- Major public health concern=50K deaths per yr in US
- Trauma is leading cause of death for people 45 yr and up
- 80-90k ppl/yr with long term disability
- 5 million ppl living with disability from TBI=$37.8 billion/yr

How does it Happen?

Incidence of Neurostorming [2]

- Estimated that 15-33% of patients with a traumatic injury experience this phenomenon
- Higher incidence of Neurostorming with Diffuse Axonal Injury
Pathophysiology

Sympathetic vs. Parasympathetic

- Sympathetic
  - Increased HR = increased CO
  - Bronchial dilation
  - Muscular contraction
  - Pupillary dilatation
  - Decreased UO, sphincter contraction
  - Decreased GI motility
  - Increased glycogen conversion
  - Adrenal release of Epi & Norepi

- Parasympathetic
  - Decreased HR = decreased CO
  - Bronchial constriction
  - Muscular relaxation
  - Pupillary constriction
  - Increased UO, sphincter relaxation
  - Increased GI motility

Other Conditions...

- Intracerebral Hemorrhage
- Subarachnoid Hemorrhage
- Brain Tumor
- Hypoxic Brain Injury
- Hydrocephalus
Concurrent Symptoms

- Hyperthermia
- Posturing
- Pupillary dilation
Concurrent Symptoms

- Tachycardia

- Tachypnea
Diagnosis

Differential Diagnosis

- Infection
- Neuroleptic Malignant Syndrome
- Malignant Hyperthermia
- Pulmonary Embolism
- Autonomic Dysreflexia
- Central Fever
- Poor sedation/pain management
- Withdraw
Differential Diagnosis

Infection
- Hyperthermia
- Tachycardia
- Tachypnea
- HYPOTENSION (sepsis)

Pharmacology

1. Pain management
2. Sedation
3. Sympathetic blockade

Pain Management

Probable drip initially
Scheduled: Ex. 5 or 10mg Roxicodone q 4 hours
PRN: for breakthroughs. Ex. Morphine 4mg q 4 hours
**Sedation**
- Probable drip initially
- PRN for breakthrough storms. Ex. Versed 4mg q 4 hours

**Sympathetic Blockade**
- Propranolol 10mg TID
- Max dose 320mg/day If combined/serlool Clonidine 0.2mg TID
- Max dose 2.4mg/day

**Inadequate Control**
- Consider:
  - Increasing propranolol
  - Precedex (titrate to effect)
  - 2nd: Bromocriptine
  - 3rd: Dantrolene
Precedex
- Start at 0.2 mcg/kg/min
- Max dose 1.4 mcg/kg/min
- Caution:
  - Bradycardia
  - Volume
  - Typically only seen in ICU

Bromocriptine
- Used for pyrexia or diaphoresis
- Start at 1.25 to 2.5 mg daily
- Max dose 100 mg

Dantrolene
- Used for dystonia or posturing
- Start 25 mg/day
- Max dose 400 mg/day
- Caution:
  - Hepatotoxic
Once you feel like you have control……

Transition Precedex to Clonidine

Remove Bromocriptine when pyrexia/diaphoresis resolve

Remove Dantrolene when dystonia/posturing resolve

Continue Propranolol & Roxicodone until GCS has stabilized

Nursing Interventions

- ID of symptoms
- Medication management
- ID of triggers
- Calming/quite environment
- Reassurance
- Family Teaching
Family Behaviors

- Exhausted
- Overwhelmed
- Fearful of loss of loved one
- Scared
- Hypervigilent
- Passive
- Distressed by symptoms
- Beginning to realize that life has changed

Case Study

At 1001 the following pt arrives to the trauma bay:

Report:
35 year old male presented as a trauma red from OSH. Rollover MVC with loss of consciousness and ejection at the scene. GCS 3 at OSH, intubated. On Diprivan drip.

Primary survey:

Airway: Intubated, 26cm at lip
Breathing: Equal bilaterally
Circulation: 2+ femoral & carotid pulses
Disability: GCS 3, pupils: L 2mm & sluggish, R 4mm & non-reactive
Exposure: minimal abrasions on bilateral shins & L dorsal hand, no active bleeding
Case Study

Vital Signs:
- RR: 19
- Temp: 37.9
- BP: 147/80
- HR: 60

Secondary Survey:
- HEMNT: L hemotympanum, midface unstable, cervical collar
- CV: S1S2, clear breath sounds bilaterally, no crepitus
- Abd: soft, nondistended
- Pelvis: stable, Foley in place
- Perineum: clear, no blood in rectum
- Back: no stepoffs, no deformity
- Extremities: mechanically stable, + pulse in all extremities

Evaluation Adjuncts:
- CXR: high position of EET, advancement recommended. No focal acute cardiopulmonary abnormality.
Case Study

Evaluation Adjuncts:

- **CT head w/o contrast @0531:**
  2. Intraventricular hemorrhage, mildly decreased. Stable nonenlarged ventricular system. The basal cisterns remain patent.
  3. Left orbital floor fracture with mild depression; no muscle entrapment. Extensive left periorbital soft tissue swelling and hemorrhage with left exophthalmos and extensive intracranial hemorrhage.

Case Study

Evaluation Adjuncts:

- **CT spine @ 0532:**
  - No acute cervical spinal pathology. Zygomatic arch fracture with dislocation from the right sphenoid bone.

Case Study

Evaluation Adjuncts:

- **CT Abd/pelvis & Chest @ 0538:**
  1. Limited examination in the absence of IV contrast.
  2. Acute fractures of the left L1 and L2 transverse processes.
  3. Debris in the proximal trachea.
  4. Possible small amount of pelvic fluid.
  5. Small left apical contusions.
Case Study

Evaluation Adjuncts:

CT head @ 0934:
1. Stable bilateral frontal and left temporal lobe hemorrhagic contusions; large dorsal left midbrain hemorrhage. Scattered subarachnoid hemorrhage has mildly progressed. Findings are consistent with shear injury and diffuse axonal injury.
2. Intraventricular hemorrhage, mildly decreased. Stable nonenlarged ventricular system. The basal cisterns remain patent.
3. Left orbital floor fracture with mild depression; no muscle entrapment. Extensive left periorbital soft tissue swelling and hemorrhage with left exophthalmos and extensive intracranial hemorrhage.

CT Abd/pelvis @ 1423:
1. Acute fractures left transverse processes L1 and L2.
2. 5.5 CM low-attenuation lesion segment 7 right lobe of liver suspicious for grade 2 hepatic injury; evaluation degraded by motion and beam hardening artifact. Follow up exam recommended. Mild fatty infiltration liver.

What were the injuries that the patient sustained?
Case Study

Summary of findings:

- Multiple facial fx
- Diffuse Axonal Injury
- Interventricular hemorrhage
- Subarachnoid hemorrhage
- Pulmonary contusions
- L1,L2 Transverse process fx
- Grade 2 liver

Case Study

Transferred to SICU:

- ICP monitor placed
- Sedation started: Propofol 10mg
- Pain medication started: 50 mcg Fentanyl
- Seizure prophylaxis: Fosphenyton q 8 hours
- 3% Saline started (Goal Na 145-155)
- Vent: PS 10/5 40%
- VS: WNL

Case Study- Hospital Day 1

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Case Study

Day 2:
- ICP monitor removed
- GCS - 4
- Vent - PS 18/5 25%
- Nutrition started
- UO – Net 1375
- Hgb - normal, WBC 21.3

Case Study

Day 2:
- ICP monitor removed
- GCS - 4
- Vent - PS 18/5 25%
- Nutrition started
- UO – Net 1375
- Hgb - normal, WBC 21.3

Case Study - Hospital Day 2

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At 11:15, you are called by the RN who tells you the patient is tachypnic, tachycardic, hypertensive, has a dilated pupil, is posturing and has spiked a fever. What is your first intervention?

1. Go see the patient
2. Increase pain/sedation or try a PRN

Differentials:
- Herniation syndrome
- Infection
Case Study - Day 2

At 1300 you get a call with the following:

- T: 39.1
- HR: 130
- RR: 30
- BP: 150/80(101)
- SPO2: 94

Patient is also posturing, both pupils 4mm & non-reactive.

What is your intervention?

- Tylenol or NSAID for fever
- Infectious work up (CXR, cultures)
- CT scan?
- Another PRN dose of Fentanyl & Versed/increase drip
- Schedule polysedation med & Tacho drip?
When you return to the next day, the patient intermittently postures, has profuse sweating (linens changed X3), tachycardia to the 140's, increased vent settings overnight for tachypnea, & hypertension.

- T: 39.4
- HR: 133
- RR: 28
- BP: 172/79 (105)
- SpO2: 96
- UO: Net -1542

What are your interventions?

- Monitor electrolytes
- Verify PRN's are being given appropriately
- Start propranolol
- Monitor bowel movements, consider bowel regimen
### Case Study - Day 4

PRN's given x2 overnight, 1 episode of profuse sweating (sheet change x1)

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What are your interventions?

- Follow infectious work up
- Monitor electrolytes
- Consider decreasing scheduled pain/sedation
- Start a bowel regimen
- Is the patient ready for early mobilization?
References


