



**Neuro-Critical Care in Emergency Medicine: Improving Outcomes on the Front Line**


January 11, 2006



**Time is Brain**



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**Introduction**

- EMS /Emergency Medicine and neuro-resuscitation
- Specialized care centers
- Emergency Medicine in neurologic emergencies research
- The Neurologic Clinical Trails Network

**EMS /Emergency Medicine and Neuro-resuscitation**

- 15 million ED visits / year for neurologic emergencies
- Potential disability is high
- Potential benefit to outcome is time dependent
- Outcome dependent on:
  - Primary insult
  - Secondary insult
  - Interventions



**Specialized Care Centers**

- Designated care centers have demonstrated a role in improving outcomes in:
  - Trauma
  - Burns
  - ? Stroke
  - ? Cardiac Disease
- What are the implications of designated centers on EMS transport and on ED overcrowding?


**CNS Insult**

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graph TD
    A[CNS Insult] --> B[secondary damage]
    A --> C[primary damage]
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**secondary damage**

- Extracerebral factors
- Stabilization of oxygenation and perfusion
- Intracranial factors

**primary damage**

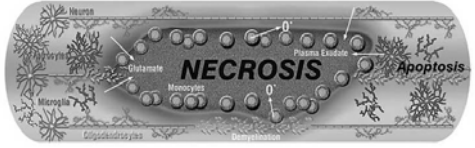


Hemorrhage, edema, ischemia, excitatory amino acids

### Structural and Physiological Changes

<p><b>Immediate Events</b></p> <ul style="list-style-type: none"> <li>• Disruption of the tissue</li> <li>• Disruption of the BBB</li> <li>• Increase in neuro transmitter levels</li> <li>• Development of edema</li> <li>• Initiation of inflammation</li> <li>• Release of free radicals</li> </ul>	<p><b>Delayed Events</b></p> <ul style="list-style-type: none"> <li>• Secondary edema</li> <li>• Hyperplasia / hypertrophy of glial cells</li> <li>• Activation of inflammatory cells</li> <li>• Release of neurotrophic factors</li> <li>• Expression of receptors for neuropeptides</li> <li>• Accumulation of free radicals and lipid peroxidation</li> <li>• Apoptosis and trans-neuronal degeneration</li> </ul>
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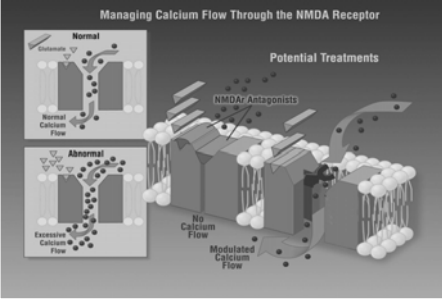
### Pathophysiology



- Early NECROTIC cellular death at focus of injury
- Extension of cellular injury continues after primary insult: ?as a result of APOPTOSIS

### Secondary Insults at the Neuronal Level


- Excitotoxic amino acids
  - Glutamate
  - Glycine
- Receptors
  - NMDA
  - AMPA/KA
  - Other



Massive calcium influx starts a cascade of deleterious events within the cell subsequently leading to cell necrosis or apoptosis.

### Improving Outcomes

- Better comprehension of pathophysiology
- Improved prehospital care
- Improved emergency care
- Targeted use of therapies
- Coordinated, multidisciplinary research



### Neurologic Clinical Trials Network

- The role of emergency medicine has been recognized as a critical component in resuscitation research
- The National Institute of Neurological Disorders and Stroke explicitly identified emergency medicine as a necessary component of the successful application for a SPOTRIAS grant
- The NINDS has recognized the need for multicenter research networks focused on neurologic emergencies

### Neurologic Clinical Trials Network

- Background: Neurologists and / or neurosurgeons are not present when many neurologic emergencies present
- Concept: A neurologic emergencies network that is not disease specific but would open opportunities for clinical research on neurologic emergencies in the prehospital and ED arenas
- A network would allow for pooling of resources

### The Hub and Spoke Model

- Clinical Coordinating Center – provides executive and steering committee governance, and management services to research centers. Facilitates rapid and rigorous completion of trials
- Hub – (10 – 20 per CCC) backbone of the network; regional and provide research and clinical infrastructure for collaborating centers (spokes)
- Spoke – (2 – 10 per hub) smaller centers which either provide on site research or refer to a hub

### NCTN Research Agenda

- High prevalence neurologic diagnoses
  - Stroke / SAH
  - Seizures
  - TBI
- Low prevalence but high morbidity and high mortality neurologic diagnoses
  - Spinal cord injury
  - Meningitis

- **Title:** Neurological Emergencies Treatment Trials (NETT) Network: Clinical Coordinating Center (U01)
- **Announcement Type:** New
- **Request For Applications (RFA) Number:** RFA-NS-06-002
- **Key Dates**
  - Release Date: November 1, 2005
  - Letters of Intent Receipt Date(s): December 12, 2005
  - Application Receipt Dates(s): January 12, 2006
  - Peer Review Date(s): April 2006
  - Council Review Date: May/June 2006
  - Earliest Anticipated Start Date: July 2006

### Summary

- EMS and Emergency Medicine are on the front line for diagnosing and managing neurologic emergencies
- Outcomes in these patients are dependent on the quality of the initial resuscitative care provided
- We are entering a new era in research that will benefit our specialty, and, most important, our patients



## Neuro-Critical Care in Emergency Medicine: Improving Outcomes on the Front Line

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What is your background:

- a. Emergency Medicine Resident
- b. Prehospital provider
- c. Emergency Medicine Faculty
- d. Nurse
- e. Physician's Assistant

What is your training background:

- a. In training
- b. Graduated < 3 years ago
- c. Graduated 4-6 years ago
- d. Graduated > 7 years ago

Which of the following is true:

- a. Cerebral perfusion pressure (CPP) is calculated using heart rate, blood pressure, and intracranial pressure
- b. Intracranial pressure (ICP) monitoring is recommended for all TBI patients with a GCS less than 9
- c. ICP is better than CPP for management decisions in the patient with TBI

In patients with traumatic brain injury, without signs of herniation, the ideal PaCO<sub>2</sub> range is:

- a. 25-28
- b. 28-32
- c. 35-38
- d. 42-46

A value that must immediately be remedied in a severe brain injury patient is:

- a. BP 140/90
- b. Glucose 85
- c. Serum Osm 308
- d. Rectal Temp 100.6
- e. Na 152

The following is a true statement regarding Capnometry (Quantitative End Tidal CO<sub>2</sub>):

- a. It correlates with PaCO<sub>2</sub>
- b. It has no utility in the monitoring of a severe brain injury patient
- c. When >40, it means the patient is hypoventilated
- d. When <30, it means the patient is being hyperventilated

Patient in status epilepticus. EMS is unable to secure an IV. Which of the following do you recommend?

- a. Rectal diazepam
- b. IM diazepam
- c. IM midazolam
- d. IM phenytoin
- e. IM narcan

Patient in status epilepticus. The nurse notes that phenytoin infusion has infiltrated into the hand. What do you recommend?

- a. Stop the infusion and administer the rest IM
- b. Continue infusion but apply warm compresses to promote absorption
- c. Inject HCO<sub>3</sub> into the site to buffer the infiltration
- d. Stop the IV, elevate the hand, call risk management

Patient in refractory status epilepticus, ie, still seizing after lorazepam, 10 mg, and phenytoin 20 mg/kg. Which of the following is your next intervention?

- a) Phenobarbital, 20 mg / kg
- b) Pentobarbital, 3 mg / kg
- c) Propofol, 1 mg / kg
- d) Valproic acid, 20 mg / kg
- e) Midazolam infusion 5 – 10 mg / hour

What are considered absolute contraindications to thrombolytic therapy in acute ischemic stroke?

- a. Age greater than 80
- b. Glucose greater than 400
- c. Stroke severity (NIHSS >20)
- d. None of the above
- e. All the above

Regarding an acute insult to the brain which is true?

- a. Nothing can be done and the injury is complete
- b. The injury develops over days but can not be stopped
- c. The injury evolves with multiple opportunities for intervention

Regarding general medical management of acute neurovascular emergencies which is true?

- a. Most patients do not require emergent management and will equilibrate over the next several days
- b. Despite physiologic abnormalities intervention is not required
- c. Physiologic abnormalities contribute to neuronal injury and should be aggressively managed

30 yo female is in an MVA hitting her head on the dash. The next day she developed a sudden onset severe right frontal HA, that persisted. One day later she developed left sided arm weakness that lasted 2 hours. In the ED she had an OD ptosis and OD miosis. Her motor / sensory exam was "WNL". What is your initial impression?

- A. Hysteria
- B. Subarachnoid bleed
- C. Epidural hematoma
- D. Carotid artery dissection
- E. Entrapment syndrome

What is the recommended empiric pharmacologic treatment for suspected acute bacterial meningitis in young adults?

- a. Ceftriaxone
- b. Vancomycin
- c. Dexamethasone
- d. None of the above
- e. All of the above

What adjunctive medications should be given in suspected acute bacterial meningitis?

- a. Mannitol
- b. Furosemide
- c. Dexamethasone
- d. None of the above
- e. All of the above

Which of the following is not characteristic of a viral meningitis:

- a. Elevated opening pressure
- b. Elevated protein
- c. Elevated glucose
- d. Elevated CSF white blood cell count

Open eyes to pain only; withdrawal flexion of right arm when IV started on the right; mumbling nonsensically. What is the GCS?

- a. 4
- b. 5
- c. 6
- d. 7
- e. 8

Which of the following is true:

- a. mannitol works by lowering blood pressure
- b. mannitol is best infused rapidly as a bolus over 30 – 60 seconds
- c. mannitol increases blood viscosity
- d. mannitol can cause renal failure

MVA – head trauma – GCS 6: vital signs stable, Pulse Ox 95% on room air. Patient agitated, not following commands – teeth clenched – swallowing spontaneously. Transport time 15 minutes. What do you recommend:

- a. Try to intubate using gentle force
- b. Sedative only oral intubation
- c. Intubation with sedative and paralytic
- d. Bag value mask support and transport

Thank You