Long-term impact & outcomes of neurological critical illness

M. Elizabeth Wilcox, MD MPH
Assistant Professor of Critical Care Medicine, University of Toronto
Staff Physician, University Health Network
Critical Care Canada Forum – 2\textsuperscript{nd} November 2016
No relevant commercial interests.
Outline

• What to expect in terms of mortality risk?
• Where is best care provided, and by who, for critically ill neurological patients?
• How, if at all, do their long-term sequelae resemble that of a general ICU patient?
• What can we learn, or adopt, from recovery pathways at care transitions of neurological patients?
How many and what do their outcomes commonly look like?

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# Long-term trajectories of neurological patients

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• What can we learn, or adopt, from recovery pathways at care transitions of neurological patients?
Improved survival with NCCU vs general ICU care

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Yes/Total</th>
<th>NCC</th>
<th>No NCC</th>
<th>p-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Warme</td>
<td>Mortality</td>
<td>23/72</td>
<td>20/49</td>
<td>0.318</td>
</tr>
<tr>
<td>Diringer</td>
<td>Mortality</td>
<td>93/266</td>
<td>310/771</td>
<td>0.131</td>
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<tr>
<td>Mirski</td>
<td>Mortality</td>
<td>15/78</td>
<td>18/50</td>
<td>0.037</td>
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<td>Elf</td>
<td>Mortality</td>
<td>9/154</td>
<td>22/72</td>
<td>0.000</td>
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<tr>
<td>Patel</td>
<td>Mortality</td>
<td>41/202</td>
<td>19/83</td>
<td>0.626</td>
</tr>
<tr>
<td>Suarez</td>
<td>Mortality</td>
<td>97/1180</td>
<td>127/1201</td>
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<tr>
<td>Varelas</td>
<td>Mortality</td>
<td>116/1279</td>
<td>110/1087</td>
<td>0.387</td>
</tr>
<tr>
<td>Lerch</td>
<td>Mortality</td>
<td>5/36</td>
<td>5/23</td>
<td>0.436</td>
</tr>
<tr>
<td>Lott (ICH)</td>
<td>Mortality</td>
<td>1199/5993</td>
<td>1461/5875</td>
<td>0.000</td>
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<tr>
<td>Lott (IS)</td>
<td>Mortality</td>
<td>314/1446</td>
<td>661/3101</td>
<td>0.760</td>
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<tr>
<td>Palminteri</td>
<td>Mortality</td>
<td>36/164</td>
<td>30/123</td>
<td>0.627</td>
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<td>Josephson</td>
<td>Mortality</td>
<td>54/296</td>
<td>29/216</td>
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<td>Samuels</td>
<td>Mortality</td>
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<td>85/317</td>
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<td>Knopf</td>
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<td>405/1372</td>
<td>278/724</td>
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<tr>
<td>Kramer</td>
<td>Mortality</td>
<td>884/2627</td>
<td>4337/1470</td>
<td>0.005</td>
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<tr>
<td>Damian (ICH)</td>
<td>Mortality</td>
<td>1694/3753</td>
<td>4337/6560</td>
<td>0.000</td>
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<td>Pineda</td>
<td>Mortality</td>
<td>2/60</td>
<td>7/63</td>
<td>0.118</td>
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<td>Varelas (SE)</td>
<td>Mortality</td>
<td>2/46</td>
<td>10/122</td>
<td>0.396</td>
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<tr>
<td>Burns</td>
<td>Mortality</td>
<td>3/37</td>
<td>1/37</td>
<td>0.327</td>
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**OR 0.72 (CI, 0.59 – 0.89; p=0.002)**

*Curr Opin Crit Care 2014; 20: 174-81.*
How Does Care Differ for Neurological Patients Admitted to a Neurocritical Care Unit Versus a General ICU?

Pedro Kurtz · Vincent Fitta · Zeynep Sumer · Hillary Jalon · Joseph Cooke · Vladimir Kvetan · Stephan A. Mayer

Published online: 26 April 2011
© Springer Science+Business Media, LLC 2011

Abstract
Background Neurological patients have lower mortality and better outcomes when cared for in specialized neuro-intensive care units than in general ICUs. However, little is known about how the process of care differs between types of units.
Methods The Greater New York Hospital Association conducted a city-wide 24-h ICU prevalence survey in March 2007. Data was collected on all patients admitted to 143 ICUs in 69 different hospitals.

Results Of 1,906 ICU patients surveyed, 231 had a primary neurological diagnosis. Of these, 52 (22%) were admitted to one of 9 neuro-ICU’s in NY and 179 (78%) to a medical or surgical ICU. Neurological patients in neuro-ICUs were more likely to have undergone tracheostomy (35% vs. 15%, $P = 0.04$), invasive hemodynamic monitoring (40% vs. 20%, $P = 0.002$), and invasive intracranial pressure monitoring (29% vs. 9%, $P < 0.001$) than patients cared for in general ICUs. Intravenous sedation was less prevalent in neuro-ICUs (12% vs. 30%, $P = 0.009$) and more patients were receiving nutritional support compared to general ICUs (67% vs. 39%, $P < 0.001$).

Keywords Neurocritical care · Outcomes research

Introduction

Recent research on outcomes of critically ill neurological patients suggests that admission to a specialized...
NCCUs reduce mortality in some conditions; step-down care maybe sufficient for others

- Gradual decrease in acute hospital mortality, **not** statistically significant, in patients with diagnosis of MG or GBS
- Reduced mortality when patients with ICH were cared for in a neurological unit

### Condition

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Not enough NCCU beds so most patients being cared for in a general ICU

If complex stay with extracerebral complications, maybe not the worst thing

Increasing sepsis, renal failure, respiratory failure, and pneumonia.
If already intensivist shortages in general ICUs …

Current and Projected Workforce Requirements for Care of the Critically Ill and Patients With Pulmonary Disease
Can We Meet the Requirements of an Increasing Demand for Intensivists?

Context: Two important areas of medicine where the need for trained intensivists will increase are pulmonary disease and critical care. This need is acute given the recent increases in smoking rates and the aging of the population.

Objective: To estimate current and future workforce needs for pulmonary/critical care physicians in the United States.

Methods: We estimated workforce needs for pulmonary/critical care physicians using hospital data sets and prospective, nation-wide surveys of hospital critical care unit (ICU) directors (n=393) and critical care specialists (pulmonologists) (n=421), conducted from 1997 through 2005.

Main Outcome Measures: Health care reform initiatives.

Results: Intensivists provided more care in ICUs in 1997. By 2000, at the rate of change, there was a 20% shortfall in supply. By 2030, this shortfall will be greater than 35%.

Conclusions: The projected workforce shortfall will result in a shortfall in intensive care medicine can be met with current policies and resources.
Integrating neurological expertise in general ICU units

Short Report

I and I is II: New Ways to Mentor and Reorganize an Inpatient Neurosurgery Service

Richard Rapport, MD¹,²,³, John Howe, MD¹, Kathy Hare, RN³, and Richard G. Ellenbogen, MD¹

Abstract
Contemporary departments in academic medical centers face challenging obstructions to the sometimes conflicted missions of education, research, and patient care. While the ward demands of patients and families have remained stable or increased, the availability of both attending faculty and residents has often decreased due to the requirements of relative value unit production and trainee duty hour limitations. The Department of Neurological Surgery at the University of Washington has evolved a novel solution to provide senior level attending coverage and bedside mentoring to help fill these gaps.

Keywords
education, techniques, neurosurgery, clinical specialty, neurohospitalist, clinical specialty
Outline

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Cognitive and Functional Outcome After Aneurysmal Subarachnoid Hemorrhage

Timour Al-Khindi; R. Loch Macdonald, MD, PhD; Tom A. Schweizer, PhD

Background and Purpose—Aneurysmal subarachnoid hemorrhage (aSAH) is a medical emergency characterized by the accumulation of blood in the subarachnoid space surrounding the brain. The acute treatment of aSAH is well documented but less is known about the long-term effects of aSAH on cognition and day-to-day functioning.

Methods—We reviewed all studies in the past 10 years that have focused on the effects of aSAH on cognition and day-to-day functioning.

Results—Sixty-one empirical studies examining cognitive and functional outcome in patients with aSAH met inclusion criteria. Survivors of aSAH commonly experience deficits in memory, executive function, and language. These cognitive impairments interact to affect patients’ day-to-day functioning, including activities of daily living, instrumental activities of daily living, return to work, and quality of life. Furthermore, these deficits are further compounded by depression, anxiety, fatigue, and sleep disturbances.

Conclusions—Much remains to be learned about the brain changes associated with aSAH and the role of diffuse brain damage and secondary complications. Further consideration of these issues is necessary to obtain a better understanding of day-to-day functioning in the long-term. (Stroke. 2010;41:e539–e536.)

Key Words: subarachnoid hemorrhage ▪ cerebral aneurysm ▪ memory ▪ executive function ▪ language ▪ depression ▪ anxiety ▪ fatigue ▪ sleep disturbances

Aneurysmal subarachnoid hemorrhage (aSAH), characterized by the rupture of an intracranial aneurysm and the subsequent accumulation of blood in the subarachnoid space, is a medical emergency associated with substantial morbidity and mortality. Only 50% of those who experience aSAH survive.

Although SAH may occur as a result of trauma, 85% of SAH cases are caused by the rupture of a cerebral aneurysm. In North America, the incidence of aneurysm rupture is approximately 8 to 11 per 100,000 persons per year. Although only 7% of all strokes are attributed to aSAH, aSAH accounts for 27% of all stroke-related years of life lost before age 65. A distinct feature of aSAH is the relatively young age at which it occurs. The peak age of incidence is between 40 and 60 years. Many survivors are in their most productive years and have major responsibilities with respect to work and family. The acute treatment of aSAH is well documented, but many questions remain about the chronic effects of aSAH on cognitive and functional outcome. The present review aims to characterize the long-term effects of aSAH on cognition, day-to-day functioning, mood, anxiety, sleep, and fatigue by considering data from clinical and neuroimaging studies. We have identified issues concerning the interpretation of data from the aSAH outcome

Discussion

Deficits in memory, executive function, and language are common cognitive sequelae of aSAH. Performance in these cognitive domains improves with time, but many “recovered” aSAH survivors continue to experience cognitive deficits 2 to 3 years later. Although several studies have documented impairments in ADLs and IADLs among “recovered” aSAH survivors, these findings may underestimate the true prevalence of impairment in day-to-day functioning. Commonly used measures of ADLs and IADLs, in addition to relying heavily on self-report, may be insensitive to the difficulties experienced by aSAH survivors when performing day-to-day tasks like preparing meals and driving. Deficits in cognitive and functional performance are further complicated by depression, anxiety, fatigue, and sleep disturbances.
Share certain in ICU risk factors for post-critical illness sequelae

Share biological pathways of global impairment

- Elevated ESR associated with hippocampal atrophy
- Smaller hippocampi associated with worse cognitive performance
- Higher ESR and CRP associated with worse memory scores

Figure. Longitudinal results of erythrocyte sedimentation rate (ESR) values according to the upper and lower quartiles of hippocampal volume.

COGnitive outcomes and WELLness in ICU survivors: COGWELL study

- Multisite, prospective, observational cohort study of rhythmic cortical electrophysiological activity [EEG], biomarkers, sleep efficiency, genetics and cognitive outcome in survivors of critical illness
- Sample size: 150 patients; 130 enrolled to date; 88 follow-up completed to 1 yr
- Registered with ClinicalTrials.gov: NCT0208687
Conceptual model: COGWELL study

Critical Illness

Sleep Disruption
(Actigraphy x 10 days; measured prior to discharge, at 6- and 12-months)

EEG Abnormalities + Biomarker profiles
(measured prior to discharge, at 6- and 12-months)

Sleep-Dependent Mechanisms

APOE ε4 allele
(genotyping; measured prior to discharge)

Acute Brain Dysfunction
(TICS/RBANS; measured prior to discharge)

Other Mechanisms of Brain Dysfunction

Long-Term Cognitive Impairment
(TICS/RBANS; measured at 6- and 12-months)

1 e.g. synaptic reorganization, changes in long-term potentiation, gene expression changes
2 e.g. hypoxic injury, drug effects, septic injury (e.g. gliosis/inflammation from microabscesses), cytokine effects
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"Strokes can occur at any age. At age 28 I survived a stroke and 4 other surgeries. I had to basically relearn all the necessities needed for life! Now at age 58, I'm independent once more. If I can do it—you can do it!"

- Daniel Dixon, Stroke Survivor
Rehabilitation actually starts in the hospital as soon as possible following a stroke. In patients who are stable, rehabilitation may begin within two days after the stroke has occurred, and should be continued as necessary after release from the hospital.

Depending on the severity of the stroke, rehabilitation options can include:

- A rehabilitation unit in the hospital with inpatient therapy
- A subacute care unit
- A rehabilitation hospital with individualized inpatient therapy
- Home therapy
- Returning home with outpatient therapy
- A long-term care facility that provides therapy and skilled nursing care

The long-term goal of rehabilitation is to improve function so that the stroke survivor can become as independent as possible. This must be accomplished in a way that preserves dignity and motivates the survivor to relearn basic skills that the stroke may have impaired - skills like bathing, eating, dressing and walking.
Rehabilitation actually who are stable, rehab should be continued a

Depending on the severity

- A rehabilitation
- A subacute care
- A rehabilitation
- Home therapy
- Returning home
- A long-term care

The long-term goal of the rehabilitation process is for patients to become as independent of caregivers as possible, and to optimize their health and quality of life. This may include activities such as bathing, eating, dressing, and walking.

The rehabilitation team may include the following professionals:

- **Physiatrist**: Specializes in rehabilitation following injuries, accidents or illness
- **Neurologist**: Specializes in the prevention, diagnosis and treatment of stroke and other diseases of the brain and spinal cord
- **Rehabilitation Nurse**: Specializes in helping people with disabilities; helps survivors manage health problems that affect stroke (diabetes, high blood pressure) and adjust to life after stroke
- **Physical Therapist (PT)**: Helps stroke survivors with problems in moving and balance; suggests exercises to strengthen muscles for walking, standing and other activities
- **Occupational Therapist (OT)**: Helps stroke survivors learn strategies to manage daily activities such as eating, bathing, dressing, writing or cooking
- **Speech-Language Pathologists (SLP)**: Helps stroke survivors re-learn language skills (talking, reading and writing); shares strategies to help with swallowing problems
- **Dietician**: Teaches survivors about healthy eating and special diets (low salt, low fat, low calorie)
- **Social Worker**: Helps survivors make decisions about rehab programs, living arrangements, insurance, and support services in the home
- **Neuropsychologist**: Diagnoses and treats survivors who may be facing changes in thinking, memory, and behavior after stroke
- **Case Manager**: Helps survivors facilitate follow-up to acute care, coordinate care from multiple providers, and link to local services
- **Recreation Therapist**: Helps stroke survivors learn strategies to improve the thinking and movement skills needed to join in recreational activities
Conclusions

• Patients with any acute illness experience shared sequelae and likely share a need for better (or “best”) integration of care pathways from the ED to rehabilitation

• Opportunities exist for collaboration when studying long-term outcomes as well as in designing intervention strategies
Questions?

elizabeth.wilcox@mail.utoronto.ca
elizabeth.wilcox@uhn.ca
Post-ICU rehabilitation therapy for general ICU pts did not improve functional recovery

- Multifaceted intervention
- No improvement in physical recovery (measured by RIM) or HRQOL but improved patient satisfaction with recovery
**Conflicting Data**

ICH patients have poor outcomes whether admitted to NCCU or seen by neurointensivist

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<th>Analysis 2</th>
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<tr>
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<td>NCCU (N = 345)</td>
<td>Other ICU (N = 146)</td>
</tr>
<tr>
<td>First ICU LOS (days)</td>
<td>7.56 ± 9.28</td>
<td>3.50 ± 4.54</td>
</tr>
<tr>
<td>Hospital LOS (days)</td>
<td>15.91 ± 21.28</td>
<td>12.96 ± 17.36</td>
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<tr>
<td>Worsened discharge disposition (discharged to higher level of care)</td>
<td>124 (36.6)</td>
<td>57 (39.6)</td>
</tr>
<tr>
<td>In-hospital death (%)</td>
<td>109 (31.6)</td>
<td>50 (34.2)</td>
</tr>
<tr>
<td>Died by 3 month F/U</td>
<td>130 (38.0)</td>
<td>57 (39.3)</td>
</tr>
<tr>
<td>Died by 12 month F/U</td>
<td>135 (39.5)</td>
<td>59 (40.7)</td>
</tr>
<tr>
<td>MBI at 3 month F/U</td>
<td>14.70 ± 6.32</td>
<td>16.13 ± 4.85</td>
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<tr>
<td>MBI at 12 month F/U</td>
<td>16.01 ± 5.51</td>
<td>16.00 ± 5.73</td>
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* = normalized using log transformation, and excluding patients who died/discharge to hospice during hospitalization

- Presence of neurointensivist associated with improved clinical outcomes; more evident in patients with SAH