INTRACEREBRAL HEMORRHAGE: STROKE RECOVERY TRAJECTORY AND OUTCOMES

Racing Against the Clock: Hyperacute/Acute Interprofessional Best Practices Day

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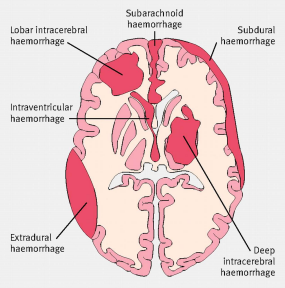
Objectives

- Review the definition of intracerebral hemorrhage and its most common causes.
- Explore prognostic tools for ICH mortality and functional outcomes
- Examine some the pattern of the ICH recovery trajectory and recognize the perihematoma in ICH as a potential source of delayed stroke recovery
- Introduce the Canadian Stroke Best Practice Recommendations that can support the rehabilitation of an ICH survivor

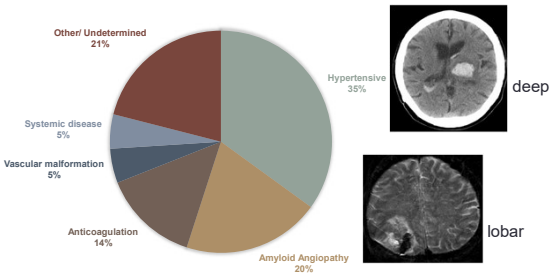
What is Intracerebral Hemorrhage (ICH)?



- In this talk, ICH refers to ***intracerebral* hemorrhage**; not to be confused with *intracranial* hemorrhage
- ICH accounts for 10-15% of all strokes

Axial illustration of the brain showing the subtypes of intracranial haemorrhage.
Rustam Al-Shahi Salman et al. BMJ 2009;339:bmj.b2586

Causes of Intracerebral Hemorrhage



deep

lobar

Stroke. 2012 Oct;43(10):2592-7.

ICH Outcomes: High Mortality

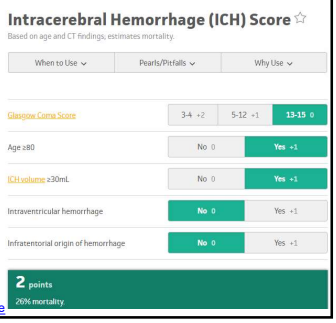
- The **30-day mortality** from ICH ranges from **35 to 52%.**
- ~50% of these deaths occur in the first two days

- Poon MT, et al. *J Neurol Neurosurg Psychiatry.* 2014;85(6):660.
  - Systematic review and meta-analysis
  - **One-year survival rate: 46%**
  - Five-year survival rate: 29%

Rordorf G, McDonald C. Spontaneous intracerebral hemorrhage: Treatment and prognosis. UptoDate. 2019.

Outcomes: High Mortality

- **ICH Score**:
  - clinical grading scale for risk stratification (mortality) on presentation with ICH
- Higher mortality with:
  - Lower Glasgow Coma Score
  - Older age (≥80)
  - Larger ICH blood volume (≥30)
  - Intraventricular hemorrhage
  - Infratentorial origin of bleed



Stroke. 2001 Apr;32(4):891-7

https://www.mdcalc.com/intracerebral-hemorrhage-ich-score

Withdrawal of support in intracerebral hemorrhage may lead to self-fulfilling prophecies

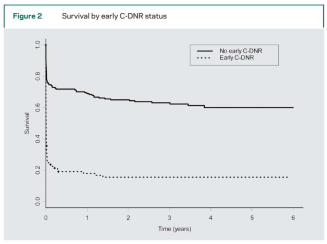
K.J. Becker, MD; A.B. Baxter, MD; W.A. Cohen, MD; H.M. Bybee, BSN; D.L. Tirschwell, MD, MSc; D.W. Newell, MD; H.R. Winn, MD; and W.T. Longstreth, Jr., MD

Article abstract—*Background:* Withdrawal of support in patients with severe brain injury invariably leads to death. Preconceived notions about futility of care in patients with intracerebral hemorrhage (ICH) may prompt withdrawal of support, and modeling outcome in patient populations in whom withdrawal of support occurs may lead to self-fulfilling prophecies. *Methods:* Subjects included consecutive patients with supratentorial ICH. Radiographic characteristics of the hemorrhage, clinical variables, and neurologic outcome were assessed. Attitudes about futility of care were examined among members of the departments of neurology and neurologic surgery through a written survey and case presentations. *Results:* There were 87 patients with supratentorial ICH; overall mortality was 34.5% (30/87). Mortality was 66.7% (18/27) in patients with Glasgow Coma Score ≤8 and ICH volume >60 cm^3. Medical support was withdrawn in 76.7% (23/30) of patients who died. Inclusion of a variable to account for the withdrawal of support in a model predicting outcome negated the predictive value of all other variables. Patients undergoing surgical decompression were unlikely to have support withdrawn, and surgery was less likely to be performed in older patients ($p < 0.01$) and patients with left hemispheric hemorrhage ($p = 0.04$). Survey results suggested that practitioners tend to be overly pessimistic in prognosticating outcome based upon data available at the time of presentation. *Conclusions:* The most important prognostic variable in determining outcome after ICH is the level of medical support provided. Withdrawal of support in patients felt likely to have a "poor outcome" biases predictive models and leads to self-fulfilling prophecies. Our data show that individual patients in traditionally "poor outcome" categories can have a reasonable neurologic outcome when treated aggressively.

NEUROLOGY 2001;56:766–772

DNAR orders as independent predictor of mortality: self-fulfilling prophecy

- Zahuranec, et al. "*Early care limitations independently predict mortality after intracerebral hemorrhage.*"
  - 270 cases of non-traumatic ICH
  - 43% mortality at 30 days, 55% mortality over the study
  - Early decision (<24 hrs) for DNR, withdrawal of care, or deferral of other life sustained interventions was associated with **doubling of the hazard for death** (**HR 2.17**, 95% CI 1.38, 3.41) **at 30 days**, despite adjusting for age, gender, ethnicity, GCS, ICH volume, intraventricular hemorrhage, and infrantentorial hemorrhage



Neurology 2007;68:1651-1657.

Do-Not-Attempt-Resuscitation (DNAR) orders as independent predictors of mortality: a self-fulfilling prophecy?

- Creutzfeldt CJ, et al. *Crit Care Med* 2011; 39(1):158-162. "Do-Not-Attempt-Resuscitation Orders and Prognostic Models for Intraparenchymal Hemorrhage"
  - Modelled 424 patients with ICH:
    - 44% had a favourable outcome, 38% died in hospital; 43% had DNAR orders
  - Observed probability of a favourable outcome (mRS ≤ 3) was:
    - significantly higher than predicted in non-DNAR patients,
    - significantly lower in DNAR patients.
- Hemphill JC III, et al. *Stroke* 2004;35:1130-1134. "Hospital Usage of Early Do-Not-Resuscitate Orders and Outcome After Intracerebral Hemorrhage"
  - In-hospital mortality after ICH is significantly influenced by the rate at which treating hospitals use DNR orders, even after adjusting for case mix.

ICH: Goals of Care

- Acute Stroke Management: Section 10. Advanced Care Planning
  - Patients surviving a stroke, as well as their families and informal caregivers, should be approached by the stroke health care team to participate in advance care planning [Evidence Level C]. (*International Journal of Stroke*, *13*(9), 949–984.)

- Outcome Prediction and Withdrawal of Technological Support: Recommendation
  - Aggressive care early after ICH onset and **postponement of new DNAR orders until at least the second full day** of hospitalization is probably recommended (*Class IIa; Level of Evidence B*). Patients with preexisting DNAR orders are not included in this recommendation. (Stroke. 2015;46:2032-2060)

Long-term functional prognosis after ICH

- Result of systematic review and pooled-analysis of four population-based studies:
- **Functional independence (mRS 0-2)** was achieved in:
  - 32.8 to 42.4% of all ICH (**53.7 to 83.7% of survivors**) **at 6 months**
  - 16.7-24.6% of all ICH (**53.8 to 57.1% of survivors**) **at 1 year**
- *If you survive ICH, chances of functional independence aren't that grim!*

Poon MTC, et al. *J Neurol Neurosurg Psychiatry* 2014;85(6):660.

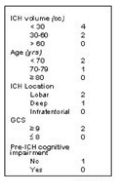
Functional Outcomes: FUNC score

- FUNC score helps to predict the likelihood of being functionally independent at 90 days
- Validated in "survivors only" cohort to get around the potential bias introduced by early withdrawal of care: similar reliability

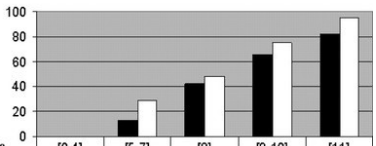
Stroke. 2008;39:2304-2309.

https://www.mdcalc.com/functional-outcome-patients-primary-intracerebral-hemorrhage-func-score

Functional Outcomes: FUNC score



FUNC Score Prediction Tool



	[0-4]	[5-7]	[8]	[9-10]	[11]
■ Entire Cohort	0	13	42	66	82
□ Survivors Only	0	29	48	75	95

% functionally independent at 90 days

Stroke. 2008;39:2304-2309.

How can we optimize functional recovery?

- **"Stroke rehabilitation** is a progressive, dynamic, goal-orientated process aimed at enabling a person with impairment to reach their optimal physical, cognitive, emotional, communicative, social and/or functional activity level."

Hebert D, Teasell R, et al. CSBPR. Stroke Rehabilitation 2015

Assessing for Stroke Rehab

- Acute Stroke Unit Care (8.1.iii.c.)

Alongside the initial and ongoing clinical assessments regarding functional status, a formal and individualized assessment to determine the type of ongoing post-acute rehabilitation services required **should occur as soon as the status of the patient has stabilized**, and **within the first 72 hours post-stroke,** using a standardized protocol (including tools such as the alpha-FIM) [Evidence Level B].

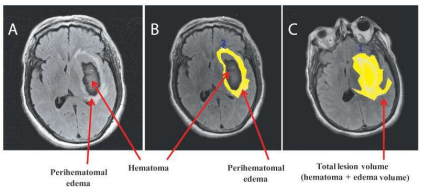
International Journal of Stroke, *13*(9), 949–984.

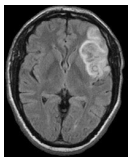
Assessing for Stroke Rehab

- Stroke Rehabilitation: Initial Stroke Rehabilitation Assessment
  - 1.iv) For patients who do not initially meet criteria for rehabilitation, **rehabilitation needs should be reassessed weekly during the first month and at intervals as indicated by their health status thereafter** [Evidence Level C].
  - *This recommendation may be particularly applicable to survivors of ICH due to the delayed recovery seen in this stroke population.*

Hebert D, Teasell R. CSBPR. Stroke Rehabilitation 2015

Delayed Recovery in Intracerebral Hemorrhage: the Perihematoma



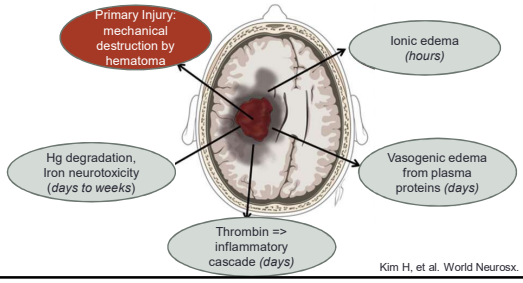


MCA superior division infarction

Stroke 2011; 42(1):73-80

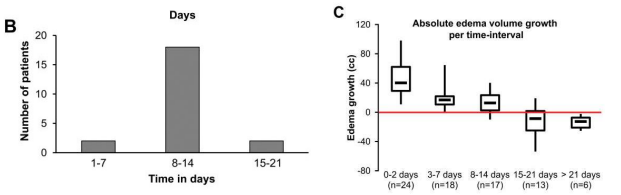
Anvekar B. 2012 <www.neuroradiologycases.com>

Delayed Recovery in Intracerebral Hemorrhage: the Perihematoma



Kim H, et al. World Neurosx. 2016; 94:32-41.

Delayed Recovery in Intracerebral Hemorrhage: the Perihematoma



Temporal profile of perihematomal edema growth after spontaneous ICH. *Stroke* 2011; 42(1):73-80.

Knowledge of recovery trajectories from population studies: South London Stroke Register

- N=3730 (14.8% ICH) from January 1995 to Dec 2011
- Mean improvement in Barthel index from 7 days to 3 months was higher in ICH (5.81) compared to ischemic stroke (2.58; p<0.001).
- Significant difference by stroke subtype remains after multivariable linear regression adjusting for case mix

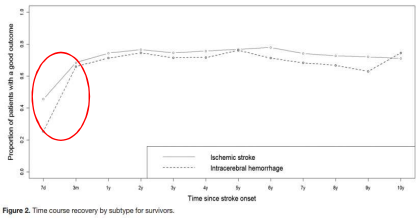
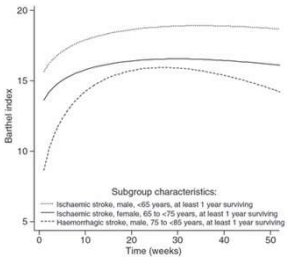


Figure 2. Time course recovery by subtype for survivors.

Bhalla, et al. *Stroke*. 2013;44:2174-2181

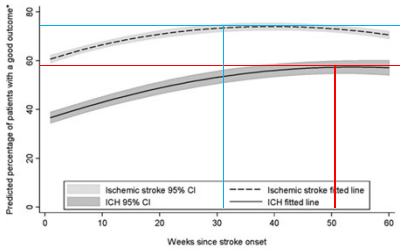
South London Stroke Register: Substudy of patient-specific recovery

- Barthel index captured at 1, 2, 3, 4, 6, 8, 12, 26 and 52 weeks post-stroke
- N=355 with at least 2 data points, average of 5.8 time points for each subject
- Patients with **ischemic stroke had significantly improved recovery curves at 1 week** after stroke (+7.024 BI points) compared to patients with hemorrhagic stroke, but, **patients with hemorrhagic stroke gained more BI points after week 1** compared to their ischemic stroke counterparts



Toschke, et al. *Eur J Neurol*. 2009; 17:219-225.

Knowledge of recovery trajectories from population studies: ChinaQUEST



- Data available in 6354 patients. Ischemic stroke: n=4782 (75%) ICH: n= 1572 (25%)
- Significant difference between the stroke subtypes when **comparing the slope of recovery (p<0.001)** *(Wald test)*.

Figure 2. Time course of recovery by stroke type. *Good outcome defined as mRS scores of <3; graphs based on nonmissing values.

Stroke. 2010;41:1877-1883

How does functional outcome change after ICH?

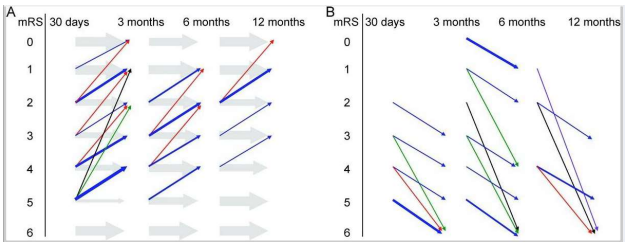


Figure 2 Change in modified Rankin Scale (mRS) score during first year after intracerebral hemorrhage (ICH)

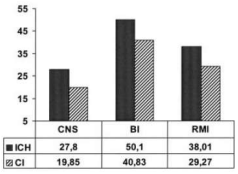
Neurology. 2009 Oct 6; 73(14): 1088–1094.

How well do patients with ICH recover with inpatient rehab compared to those with ischemic stroke?

- Katrak PH, et al. *PM R*. 2009; 1:427–433.
  - Consecutive stroke admissions: 129 ICH patients and 589 ischemic stroke
  - ICH vs Ischemic:
    - More severely disabled at admission
    - Achieved greater FIM efficiency and a greater Motor Assessment Scale (MAS)
    - Stroke type remained a significant factor for FIM gain even when adjusting for admission FIM, length of stay, age, and days from stroke onset to rehab admission
- Kelly PJ, et al. *Arch Phys Med Rehabil* 2003;84:968-72.
  - Retrospective study of consecutive stroke admissions over a 4-year period; N=1064 (193 ICH)
  - Lower admission FIM score in ICH
  - FIM gain was greater in ICH than IS (28 vs. 23.3; p=0.002)
  - ICH patients with the most severely disabling strokes had significantly greater recovery than cerebral infarction patients with stroke of similar severity

Functional Outcome after Inpatient Stroke Rehabilitation

- Case-control study
- N= 270 first-time stroke:
  - 135 ischemic stroke
  - 135 ICH
- Matched comparison: stroke severity, basal disability, age (within 1 year), sex, and onset-admission interval
- Hemorrhagic stroke conferred a high therapeutic response on Barthel Index (**OR: 2.48**, 95% CI 1.13 to 5.20) compared to ischemic stroke



	CNS	BI	RMI
ICH	27,8	50,1	38,01
CI	19,85	40,83	29,27

Figure 2. Effectiveness on neurological (CNS) and functional (BI and RMI) recovery (CNS <0.01, F=7.53; BI <0.05, F=6.34; RMI <0.01, F=6.94).

Paolucci S, et al. *Stroke* 2003;34:2861-2865.

ICH Recovery Trajectory: Some Conclusions

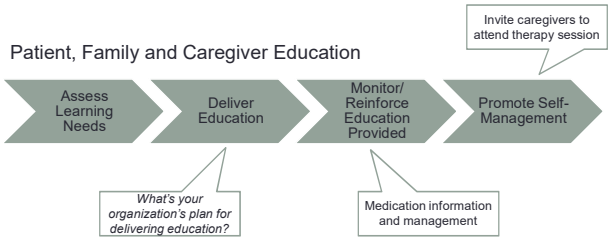
- Functional gains/recovery in ICH often **delayed**; often starting after the first week
  - Patients with ICH may require repeat assessments for eligibility and goals of rehabilitation
- Compared to survivors of ischemic stroke, survivors of ICH **make steeper gains** after the acute phase
- ICH functional recovery **continues up to 12-months post stroke**

How do we support stroke recovery?

- Managing Stroke Transitions of Care, CSBP 2015
  - A focus on **patient-centred care**
    - patient, family members and caregivers should be involved in decision-making, goal setting, care planning
  - **Monitor caregiver** capacity, coping, and risk for depression
    - Stroke affects the whole family unit!
  - Call to action for all healthcare professionals to **deliver education and support** on an ongoing basis
    - *Examples of support::*
      - Written discharge instructions (follow-up care, goals)
      - Access a contact person for care continuity
      - Links to local resources: stroke survivor groups, meal provider agencies, etc.
      - Access to restorative care and active rehabilitation
      - Advance care planning, palliative care as appropriate

How do we support stroke recovery?

Patient, Family and Caregiver Education



Cameron JI, et al. CSBP 2015. www.strokebestpractices.ca

Supporting Stroke Recovery: Patient, Family and Caregiver Education

- *What are some possible patient education topics?*
- *What are important family and caregiver topics?*

Patient education topics[a]	Family and caregiver education topics
☐ Exercise	☐ Training in personal care techniques (e.g. feeding techniques)
☐ Symptom management techniques	☐ Communication strategies
☐ Risk factor management (including drug adherence)	☐ Physical handling techniques (e.g. transfers from bed to chair, positioning of a hemiplegic limb)
☐ Secondary stroke prevention	☐ Food preparation and modifications for patients with dysphagia
☐ Nutrition	☐ Education on the self-management model to encourage patient independence when possible
☐ Fatigue and sleep management	☐ How to access community services and resources
☐ Medication management	☐ Problem-solving techniques
☐ Coping with physical changes	☐ Respite care options
☐ Coping with emotions such as fear, anger and depression	☐ Ongoing health system navigation
☐ Coping with cognitive and memory changes	☐ End-of-life and palliative care options
☐ Coping with perceptual deficits	
☐ Training in communication	
☐ Health-related problem-solving and decision-making	
☐ Relationships and sexuality	
☐ Community reintegration including leisure and driving	

[a]Topics may be applicable to families and caregivers as well as patients.

Cameron JI, et al. CSBP 2015. www.strokebestpractices.ca

How do we support stroke recovery?

- Good interprofessional care planning and communication
  - Are appropriate discharge plans in place?
    - Planned appointments
    - Communication of ongoing recovery needs and goals
- Support community reintegration following stroke
  - Vocation: work, volunteering, school
    - Return-to-work plans
    - Social worker: benefit options, financial concerns
  - Leisure
    - Can rehabilitation needs goals be targeted to pre-stroke leisure activities?
    - Return to driving?
      - Screen at 1-month for residual sensory/motor/cognitive deficits. OT driving assessments.
- Rehabilitation and Restorative Care
  - Stroke survivors with ongoing rehabilitation goals should continue to have access to specialized stroke services (e.g. PT, OT, SLP), even if in LTC setting.

Cameron JI, et al. CSBP 2015. www.strokebestpractices.ca

The most common cause of intracerebral hemorrhage:

- A) Cerebral amyloid angiopathy
- B) Vascular malformations
- C) Hypertension
- D) Subdural bleeds related to anticoagulation
- E) Post-thrombolytic (tPA) bleeds into ischemic infarct (*probably because they keep extending the window!*)

A 70 year old man presents to ER via EMS after collapsing with right weakness. In this case, which of the following would be a risk factor for increased mortality related to ICH?

- A) Supratentorial location of bleed
- B) Arriving with a Glascow Coma Score of 13
- C) Age of 70
- D) ICH volume
- E) Intraventricular hemorrhage

Mortality in ICH is high. Among for survivors of ICH, the chances of achieving a favourable outcome (mRS 0-2) at 1-year are approximately:

- A) 55%
- B) 40%
- C) 30%
- D) 15%
- E) 5% (*Only choose this answer if you are very pessimistic!)*

Recommended Resources:

- www.strokebestpractices.ca
- ebrsr.com
- strokeengine.ca

Summary

- ICH carries a high mortality in the acute phase (35-52
- ICH survivors make **substantial functional recoveries** but in a **delayed and protracted** fashion compared to ischemic stroke cohorts; around 55% of survivors will make a favourable outcome; the FUNC score is a helpful prognostic tool
- Intracerebral hemorrhage survivors are likely to require repeat assessments for rehab candidacy
  - **Perihematomal edema**, which peaks **~8-14 days**, may account for delayed recovery in ICH.
- Canadian Stroke Best Practice Recommendations call for patient-centred care and education to best support recovery; we all have a role!