

Age as a Predictor of Functional Outcome in Anoxic Brain Injury

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ABSTRACT

Objective: To compare the functional outcomes of young and older patients with anoxic brain injury.

Design: Retrospective chart review.

Setting: Freestanding rehabilitation hospital.

Participants: Thirty-four patients with anoxic brain injury (ABI), 18 patients less than 50 years old and 16 patients greater than 50 years old.

Intervention: Comprehensive multidisciplinary rehabilitation services.

Measurements: Data analyzed included demographic characteristics, rehabilitation hospital length of stay and cost; Functional Independence Measure (FIM) scores and its various subsets on admission and discharge; FIM efficiency and change; and discharge disposition.

Results: Both ABI groups were similar in terms of demographic variables except for age at time of injury. The older group had a shorter length of stay and a lower cost of rehabilitation, but the charges per day were no different from the younger group. In both groups,

over 70% of patients were discharged to home.

Conclusions: The present study suggests that older anoxic brain injury patients do benefit from inpatient rehabilitation and make gains similar to the younger patients in a shorter length of stay and with lower cost. Therefore, advanced age should not be exclusion criteria for admission to rehabilitation as both groups made significant gains with similar discharge to home rates.

INTRODUCTION

Anoxic brain injury (ABI) is a devastating injury that leads to significant impairments in memory, cognition, and attention.¹ Numerous studies have shown that patients with ABI tend to have poor outcomes.²⁻⁴ However, most of the literature focuses upon mortality and discharge rates from the acute hospital and not on outcomes after rehabilitation.^{2,3,5} There are only a few studies that have examined outcomes of patients with ABI after rehabilitation.^{1,6}

Age at the time of injury is known to be an important variable in the prognosis of a brain injury.⁷ However, very few studies have examined the effect of age at the time of injury on the outcomes of patients with ABI after rehabilitation. Groswasser et al studied 31 patients with ABI and found that patients who were older than 25 years

of age tended to have poorer outcomes.¹ Schmidt et al studied 26 patients with ABI and found that there was no correlation with age and outcome.⁶

The purpose of this study was to determine whether age was a predictor of functional outcomes in patients with ABI by comparing young patients to older patients after inpatient rehabilitation.

METHODS

Subjects

Charts of patients admitted to a free-standing rehabilitation hospital over the last 4 years with the diagnosis of ABI (ICD-9 code 310.1 or 348.1) were retrospectively reviewed. The accuracy of this diagnosis was obtained from the chart. Patients were divided into two categories, young (<50 years old) and older (>50 years old). This search resulted in 34 patients, 18 in the young group and 16 in the older group, for inclusion in this study. Records were reviewed with the approval of the Institutional Review Board.

Measures

Complete demographic, clinical, and outcome data were obtained for comparison from the charts of both cohorts of patients. Demographic information included age, sex, race, and marital status. Outcome measures compared included the Functional Independence Measure (FIMTM) and its subsets on admission and discharge, rehabilitation length of stay (LOS), the financial cost of rehabilitation, and discharge disposition. The 3 subsets of the FIM that were analyzed were the activities of daily living subset (ADL, FIM items 1-6), mobility subset (MOB, FIM items 9-13), and cognition subset (COG, FIM items 14-18). Other parameters analyzed included the FIM change (defined as the difference between admission and discharge FIM scores) and FIM efficiency (defined

as the FIM change divided by the LOS). The FIM efficiency reflects the mean gain in scores per day.

Statistical Analysis

Descriptive statistics were computed for all relevant variables. StatXact5 from Cytel Software Corporation (StatXact, Cytel Software, Cambridge, Massachusetts, USA) was used to perform the non-parametric tests after normality and constant variance were checked and found not to be valid. A *P* value of < 0.05 was considered statistically significant.

RESULTS

Demographics Characteristics

The average age of the young patients with ABI was 34.1 years of age (range 18-48 years old, SD 10.5 years) while the average age of the older patients with ABI was 64.1 years of age (range 53-80 years old, SD 8.8 years). There was a significant difference between the ages of the two groups (*P*=<0.001). The vast majority of patients in both groups were white and married. There were no inter-group differences based on ethnicity, gender, or marital status.

In the young patient ABI group, 7 (38%) had sustained a cardiac arrest, 3 (17%) had respiratory failure, 3 (17%) had a near drowning episode, 3 (17%) were suicides by illicit drug use or hanging, and 2 (11%) had hypotensive episodes. In the older patient ABI group, 11 (69%) had sustained a cardiac arrest, 2 (11%) had hypotensive episodes, 2 (11%) had respiratory failure, and the rest were post-surgical patients.

Discharge Disposition

Table 1 also describes the discharge dispositions of the two groups after inpatient rehabilitation. The majority of patients in both groups were discharged to home. There was a trend for a larger

Table 1. Demographic Characteristics and Discharge Disposition of Anoxic Brain Injury Patients

	<u>Younger</u> n (%)	<u>Older</u> n (%)	<i>P</i> value
Mean Age (years)	34.2 ± 10.5	64.1 ± 8.8	<0. 001
Range (years)	18 – 48	53 –80	
Sex			
Male	11 (61)	9 (56)	0.782
Female	7 (39)	7 (44)	
Ethnicity			
White	14 (78)	13 (81)	
African American	1 (6)	3 (19)	0.201
Asian	0 (0)	0 (0)	
Other	1 (6)	0 (0)	
Hispanic	2 (11)	0 (0)	
Marital Status			
Single	5 (28)	1 (6)	0.163
Married	11 (61)	11 (69)	
Widowed	0 (0)	1 (6)	
Divorced	2 (11)	3 (19)	
Discharge Disposition			
Home	13 (72)	13 (81)	0.682
Nursing Home Facility	4 (22)	2 (13)	
Acute Care Hospital	1 (6)	1 (6)	

number of ABI patients in the young group (22%) to be discharged to a skilled nursing facility compared to the older group (13%).

Measures of Functional Status

The functional status of the two groups was compared using the FIM on admission and discharge. In addition, the improvement per day was evaluated by comparing the FIM efficiency scores. Table 2 describes the mean FIM scores and the FIM subsets compared between the two groups. The difference between the FIM scores and FIM subsets for the two groups was not significant.

Length of Stay, Charges, and Efficiency of Rehabilitation

As shown in Table 3, the average length of stay for the young patients with ABI was 65.9 days ± 74.9 days and for the older patients with ABI was 54.6 days ±

39.0 days. There were no significant differences observed between the two groups with regards to inpatient rehabilitation LOS ($P= 0.67$).

The median charges for the young ABI patient group was \$59,235.00 as compared to \$53,666.00 for the older ABI patient group. The average charge per day, an index of efficiency of inpatient rehabilitation, for the young group was \$899.00 while for the older group it was \$982.53. There were no statistical differences between the groups based on charges.

DISCUSSION

This goal of this study was to compare the functional outcomes of ABI patients 50 years of age and younger to ABI patients older than 50 in an inpatient rehabilitation setting. Overall, this study reviewed 34 ABI patients, 18 young patients and 16 older patients, who were

Table 2. Functional Status using the FIM*

	Younger ABI	Older ABI	P value
FIM Activity of Daily Living-Admission	20.00 ± 12.09	19.5 ± 11.31	0.932
FIM Activity of Daily Living-Discharge	30.06 ± 14.39	29.25 ± 12.12	0.443
FIM Activity of Daily Living-Efficiency	0.387 ± 0.428	0.262 ± 0.208	0.878
FIM Cognition-Admission	16.22 ± 9.15	18.62 ± 9.13	0.384
FIM Cognition-Discharge	23.28 ± 11.31	24.75 ± 9.34	0.959
FIM Cognition-Efficiency	0.278 ± 0.405	0.204 ± 0.246	0.798
FIM Mobility-Admission	13.28 ± 8.84	10.69 ± 6.78	0.551
FIM Mobility-Discharge	26.28 ± 11.21	22.63 ± 10.95	0.365
FIM Mobility-Efficiency	0.527 ± 0.571	0.545 ± 0.745	0.986
†Total FIM-Admission	57.0 ± 33.12	55.81 ± 29.77	0.986
†Total FIM-Discharge	86.68 ± 23.23	87.06 ± 38.19	0.695
†Total FIM-Efficiency	1.26 ± 1.49	1.05 ± 1.02	1.00

*FIM, Functional Independent Measure, ADL, activities of daily living.
†FIM measures are reported on a scale ranging from 0 (totally dependent in all parameters) to 126 (completely independent in all functional domains).

Table 3. Charges and Length of Stay

		Average	Std Dev	Minimum	Median	Maximum	P value
LOS*	Young	65.89	74.858	3	35	258	0.67
	Older	54.62	38.99	6	40	131	
Charges†	Young	56,614.85	67,316.40	4,112.00	31,644.50	319,685.00	0.746
	Older	65,926.15	54,856.83	4,550.00	51,725.00	212,328.00	

*LOS indicates length of stay. †Charges are in US dollars.

admitted to an acute brain injury rehabilitation unit in a freestanding rehabilitation facility. Both groups were comparable in demographic characteristics with the exception of age. The results of this study found that both the functional ability on admission and discharge of both groups of ABI patients were similar as measured by the FIM and its subsets. Overall, both groups made significant gains in cognition, ADLs, and mobility during their rehabilitation stay.

There is only one other study that has used the FIM as a measure of functional outcome in patients with ABI. Schmidt et al⁶ studied 26 patients with ABI and found that patients did make great gains during rehabilitation. The mean age of their population was 58

years old (range 24-82). The functional outcome of this study was similar to that of Schmidt et al, except that the patients in our study made better cognitive gains during rehabilitation. Both groups of patients had similar admission characteristics.

Groswasser et al studied 31 patients with ABI and found that age was a predictor of outcome.¹ The mean age of the patients in their study was 37 years old (range 4-73). They stated that rehabilitative efforts should focus on patients less than the age of 30, since these were the patients that had a better vocational outcome in their study. However, the results of our study showed that older patients (>50 years of age) not only were functional the same as younger patients upon discharge, but they stayed

in the rehabilitation hospital 11 days less with hospital costs about \$6,000 less during their rehabilitation stay. Older patients were discharged to home at a similar rate (>80%). Our results are supported by Schmidt et al's findings, which concluded that age was not a predictor of functional outcome.⁶

The results of this study challenges the current literature which states that older ABI patients have a poorer prognosis than younger ABI patients and are not likely to benefit from rehabilitation. We suggest that older ABI patients do benefit from rehabilitation and have similar functional outcomes with a shorter length of stay and lower cost when compared to younger ABI patients. This study shows that there should not be an age bias for admission to rehabilitation as the older group had over 80% of patients being discharged to home. The results of this study are important as more of the population becomes over the age of 50 and are surviving brain injuries.

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