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

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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 Medical support was withdrawn in 76.7% (23/30) of patients who died.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 Patients undergoing surgical decompression were unlikely to have support withdrawn, and surgery was less likely to be performed in older patients ($p 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.

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Clinical and radiographic information are used to predict outcome in intracerebral hemorrhage (ICH). The predictive value of this information has been proven in retrospective and prospective patient cohorts.[1-3] The prognostic variables are derived, however, from patient populations in whom withdrawal of support has been allowed, and withdrawal of support invariably leads to death. Therefore, if the treating physician or the patient's family members anticipate a bad outcome based on particular clinical and radiographic findings and decide to withdraw support, the patient's death could lead to self-fulfilling prophecies about the predictive value of those clinical and radiographic variables.[4-6]

The most important variables for prognostication of ICH are the hematoma volume and the initial Glasgow Coma Score (GCS).[1,2] Most studies report a 30-day mortality >90% in patients with ICH volume >60 to 65 cm^3 and GCS ≤8.[1,2] The risk of death increases with the presence of intraventricular hemorrhage (IVH),[3] and is proportional to the volume of IVH.[7] Hydrocephalus,[8] active bleeding,[9] the degree of midline shift,[10] hyperglycemia,[10] and marked hypertension[10,11] or a widened pulse pressure[2] also portend a bad outcome.

Prospective clinical trials show no role for surgery in the treatment of supratentorial ICH,[12] yet surgery is performed routinely in many institutions. Current prognostic models do not adequately address the effect of surgery on outcome nor do they account for the biases involved in selecting surgical candidates. We studied how withdrawal of support and surgical intervention affect prognostic models for ICH among patients treated at a single academic hospital. We also evaluated whether the clinicians caring for these patients had preconceived notions about futility of care.

Methods. We identified subjects through a radiology database of consecutive patients with ICH undergoing CT and CT angiography (CTA) from 1994 to 1997.[9] Patients with history of trauma or evidence of tumor, subarachnoid hemorrhage, aneurysm or other vascular malformation on CT scan or follow-up studies were excluded from analysis. CT scans were reviewed independently by two neuroradiologists (A.B.B., W.A.C.) blinded to the clinical data. Only patients with supratentorial hemorrhage are included in this study. The scans were analyzed for hematoma volume

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(using the ABC ÷ 2 method[13]), hematoma location (basal ganglia or thalamus versus lobar), IVH, cisternal effacement, midline shift, uncal herniation, and affected hemisphere. Intraventricular hemorrhage was considered small if blood was visible in only one ventricular chamber and extensive if visible in more than one chamber. Discrepancies in qualitative evaluations were adjudicated; hematoma size was calculated as the average of both neuroradiologists' values.

Patient age, gender, elapsed time from symptom onset to presentation and CT scan, pulse pressure, mean arterial blood pressure, GCS score, pupil asymmetry, and initial glucose level were obtained through chart review. Surgical intervention (decompression of the hemorrhage), withdrawal of medical support, and discharge status (home, rehabilitation, skilled nursing facility, or death) were assessed. Functional status (modified Rankin Scale [mRS]) at long-term follow-up (when possible) was determined in selected cases. Primary outcome measures included in-hospital mortality, surgical intervention, and the decision to withdrawal support.

House staff and faculty members from the departments of neurology and neurologic surgery participating in direct care of patients with ICH at the hospitals within our institution were surveyed anonymously regarding perceptions about futility of care in the treatment of patients with spontaneous supratentorial ICH. The survey included directed questions about the clinical and radiographic variables abstracted above. The level of functional recovery, based on the mRS, felt worthy of salvage was also queried. A series of four actual cases were presented in brief, and the respondents were asked to decide whether, given the data, they would: 1) opt for decompressive surgery, 2) offer surgery only if the patient deteriorated, 3) offer aggressive medical care only, or 4) withdraw support. Responses were contrasted to the historical intervention and outcome.

Continuous data are displayed as the median and interquartile range; categorical data as "n (%)." Univariate analyses for associations with outcome were performed using the χ^2 test statistic for categorical and dichotomous data; the Mann-Whitney *U* test statistic was used for continuous data. Independent associations with outcome, surgical intervention, and the decision to withdrawal support were determined using a stepwise logistic regression model. Variables were entered into the model for univariate $p \leq 0.05$. Statistical analyses were performed using SPSS version 10.0 (SPSS, Chicago, IL); significance was set at two-tailed $p < 0.05$. All studies were approved by the Institutional Review Board.

Results. Clinical and radiographic data were available for 112 patients. Of these 112 patients, 87 had supratentorial ICH and are the subject of this paper. The median time from symptom onset to presentation was 195 minutes (range, 89 to 390); median time from symptom onset to CT scan was 354 minutes (range, 222 to 597). In-hospital mortality was 34.5% (30/87). The GCS score and hematoma volume were highly correlated ($p < 0.001$; Spearman's ρ). The clinical and radiographic characteristics of these patients, as well as univariate associations with outcome, are displayed in table 1. In a multivariate model including information available to the clinician at the time of presentation—age, gender, GCS score (as a continuous variable), ICH volume (as a continuous variable), IVH, midline shift, uncal herniation, cisternal effacement, location of the hemorrhage (lobar versus ganglionic or thalamic), and glucose level, in that order—the only independent predictor of death was the initial GCS score (OR, 1.23 per point decrease; 95% CI, 1.02 to 1.48; $p = 0.03$); there was a trend toward decreased survival with increasing age (OR, 1.63 per decade; 95% CI, 1.00 to 2.66; $p = 0.05$). Cisternal effacement, midline shift, and uncal herniation represented a spectrum of degrees of mass effect and were highly correlated ($p < 0.01$ for all associations). If midline shift was used as the only CT marker of mass effect, GCS score (OR, 1.16 per point decrease; 95% CI, 1.00 to 1.35; $p = 0.049$), hematoma volume (OR, 1.18 per 10 cm^3; 95% CI, 1.00 to 1.40, $p = 0.04$), and age (OR, 1.62 per decade; 95% CI, 1.02 to 2.57; $p = 0.04$) become independent predictors of outcome. If uncal herniation was used as the only CT marker of mass effect, GCS score (OR, 1.23 per point decrease; 95% CI, 1.03 to 1.47; $p = 0.02$) and hematoma volume (OR, 1.20 per 10 cm^3; 95% CI, 1.00 to 1.44; $p = 0.046$) remained independent predictors of outcome. If cisternal effacement was used as the only CT marker of mass effect, GCS score (OR, 1.22 per point decrease; 95% CI, 1.02 to 1.45; $p = 0.03$) and age (OR, 1.58 per decade; 95% CI, 1.00 to 2.49; $p = 0.048$) predicted outcome.

When the decision to perform surgical decompression was entered into the model using all three CT markers of mass effect, lack of surgery (OR, 200; 95% CI, 5.99 to ∞; $p = 0.003$) and midline shift (OR, 10.2; 95% CI, 1.29 to 83.3; $p = 0.03$) were associated with in-hospital mortality. In models using either cisternal effacement or uncal herniation, respectively, as CT markers of mass effect, hematoma volume (per 10 cm^3) (OR, 1.08; 95% CI; 1.08 to 1.82; $p = 0.01$ and OR, 1.4; 95% CI, 1.07 to 1.84; $p = 0.02$) and lack of surgery (OR, 125; 95% CI, 4.39 to ∞; $p = 0.005$ and OR, 776.9; 95% CI, 3.98 to 1000; $p = 0.004$) were associated with in-hospital death. In the model using midline shift as the CT marker of mass effect, lack of surgical intervention was the only independent predictor of in-hospital death (OR, 58.8; 95% CI, 4.29 to 1000; $p = 0.002$). When a variable accounting for the decision to withdraw medical support was included in any of these models, no other variables remained significant.

Of the 30 patients that died, medical support was withdrawn in 23 (76.7%); withdrawal of support invariably led to death. Table 1 displays univariate predictors of the decision to withdraw support. When controlling for information available at admission and significant in the univariate analysis (age, GCS score, ICH volume, extensive IVH, midline shift, uncal herniation, and cisternal effacement [in that order]), there was a trend for support to be withdrawn more frequently in older patients (OR, 1.61 per decade; 95% CI, 1.00 to 2.59; $p = 0.050$). Using midline shift as the sole CT marker of mass effect, age was significant (OR, 1.60 per decade; 95% CI, 1.02 to 2.51; $p = 0.04$). When a variable accounting for surgical intervention was added to either model, it negatively predicted withdrawal of support: for all three CT variables of mass effect, the OR was 0.07 (95% CI, 0.01 to 0.76; $p = 0.03$), and for midline shift alone, the OR was 0.09 (95% CI, 0.01 to 0.81; $p = 0.03$). The median length of stay among patients in whom support was withdrawn was 2 days (range, 1 to 4), suggesting that the decision to withdraw support was made very early in the hospital course and that death rapidly ensued.

Table 1 *Determinants of primary outcomes*

Characteristic	Survived to discharge			Support withdrawn			Surgical intervention		
	Yes, n = 57	No, n = 30	*p* Value	No, n = 64	Yes, n = 23	*p* Value	Yes, n = 21	No, n = 66	*p* Value
Age, y	59.0	67.5	0.06	58.5	68.0	0.01	55.0	64.0	0.02
	(48.0–70.0)	(55.0–74.2)		(48.2–69.5)	(56.0–75.0)		(45.5–64.5)	(52.5–74.2)	
Men	30 (52.6)	18 (60.0)	0.51	34 (53.1)	14 (60.9)	0.52	11 (52.4)	37 (56.1)	0.42
Time to presentation, min	252	150	0.20	245	150	0.28	189	205	0.49
	(103–440)	(81.2–287)		(94.5–440)	(83.8–276)		(46.5–385)	(110–390)	
Time to CT scan, min	386	294	0.16	365	285	0.35	354	340	0.37
	(240–700)	(177–452)		(237–659)	(192–469)		(268–1104)	(216–578)	
GCS score	12	4	<0.001	11	4	<0.01	8	9	0.94
	(6–15)	(3–8)		(4–14)	(3–9)		(3–14)	(3–14)	
GCS score ≤8	20 (35.1)	23 (76.7)	<0.001	26 (40.6)	17 (73.9)	<0.01	11 (52.4)	32 (48.5)	0.76
Patients with asymmetric pupils	11 (19.3)	10 (33.3)	0.12	15 (23.4)	6 (26.1)	0.72	4 (19.0)	17 (25.8)	0.50
Glucose, mg/dL	151	176	0.01	152	165	0.16	151	160	0.76
	(120–182)	(155–211)		(121–191)	(148–190)		(127–180)	(120–198)	
Glucose >180 mg/dL	15 (26.3)	15 (50.0)	0.03	21 (32.8)	9 (39.1)	0.58	5 (23.8)	25 (37.9)	0.24
MABP, mmHg	117	120	0.63	117	120	0.72	117	118	0.55
	(104–139)	(106–134)		(104–140)	(106–133)		(99.0–127)	(105–138)	
MABP >120 mmHg	25 (43.9)	14 (46.7)	0.80	28 (43.8)	11 (47.8)	0.74	9 (42.2)	30 (45.5)	0.84
Pulse pressure	62.5	69.0	0.14	63.0	74.0	0.18	54.0	67.0	0.06
	(49.2–77.5)	(58.0–88.0)		(49.0–78.0)	(58.5–86.5)		(38.0–76.0)	(56.0–84.2)	
ICH volume, cm^3	37.5	90.2	<0.001	39.1	88.8	<0.01	63.7	40.4	0.21
	(21.8–65.2)	(49.0–139)		(22.3–73.1)	(40.9–88.8)		(40.3–100)	(23.2–87.4)	
ICH >60 cm^3	17 (29.8)	21 (70.0)	<0.001	24 (37.5)	14 (60.9)	0.05	12 (57.1)	26 (39.4)	0.15
ICH location									
Right hemisphere	24 (42.1)	14 (46.7)	0.98	25 (39.1)	13 (56.6)	0.22	14 (66.7)	24 (36.4)	0.01
Lobar, n = 42	32 (76.2)	10 (23.8)	0.04	34 (81.0)	8 (19.0)	0.13	14 (33.3)	28 (66.7)	0.05
BG or thalamic, n = 45	25 (55.6)	20 (44.4)		30 (66.7)	15 (33.3)		7 (15.6)	38 (84.4)	
Any IVH	35 (61.4)	25 (83.3)	0.04	42 (65.6)	18 (78.3)	0.26	13 (61.9)	47 (71.2)	0.42
Extensive IVH	20 (35.1)	20 (66.7)	<0.01	24 (37.5)	16 (69.6)	<0.01	7 (33.3)	33 (50.0)	0.18
Signs of mass effect									
Cisterns effaced	5 (8.8)	12 (40.0)	0.001	9 (14.1)	8 (34.8)	0.04	5 (23.8)	12 (18.2)	0.54
Midline shift	26 (45.6)	26 (86.7)	<0.001	33 (51.6)	19 (82.6)	<0.01	17 (81.0)	35 (53.0)	0.02
Uncal herniation	7 (12.3)	15 (50.0)	<0.001	12 (18.8)	10 (43.5)	0.03	6 (28.6)	16 (24.2)	0.65
Surgical decompression	20 (35.1)	1 (3.3)	0.001	20 (31.3)	1 (4.3)	0.01			
Withdrawal of support	57 (100)	23 (76.7)	<0.001				1 (4.8)	22 (33.3)	0.01
Death or discharge to SNF				20 (31.3)	23 (100)	<0.001	5 (23.8)	38 (57.6)	<0.01

Continuous variables expressed as median and interquartile range; categorical variables expressed as n (%). Continuous variables assessed using the Mann-Whitney *U* test; dichotomous or categorical variables using χ^2.

GCS = Glasgow Coma Scale; MABP = mean arterial blood pressure; ICH = intracerebral hemorrhage; BG = basal ganglionic; IVH = intraventricular extension of hemorrhage; extensive IVH = blood within two or more chambers; SNF = skilled nursing facility.

Univariate predictors of lack of surgical intervention are presented in table 1. In the multivariate analysis (age, midline shift, hematoma location, and side of hematoma, [in that order]), older age (OR, 1.82 per decade; 95% CI, 1.17 to 2.82; $p = 0.008$), midline shift (OR, 0.14; 95% CI, 0.02 to 0.76; $p = 0.02$), and left hemispheric lesions (OR, 0.25; 95% CI, 0.07 to 0.91; $p = 0.04$) independently predicted lack of surgical intervention. Neither the GCS score nor the hematoma volume (as continuous variables) achieved significance when added to the multivariate model.

Studies suggest that patients with hematomas >60 cm^3 and GCS score ≤8 have very little chance (9%) of survival.[1]

Table 2 *Patients with GCS score ≤8 and hematoma >60 cm³; predictors of discharge to rehabilitation or home*

Characteristic	Rehabilitation or better, n = 6	SNF or death, n = 20	*p* Value
Age, y	52.0 (39.5–66.2)	65.5 (55.2–73.8)	0.08
Men	1 (16.7)	13 (65.0)	0.04
Time to presentation, min	189 (144–280)	142 (90.0–271)	0.02
Time to CT scan, min	340 (250–690)	285 (164–409)	0.50
GCS score	6 (3–7)	3 (3–4)	0.08
Patients with asymmetric pupils	1 (16.7)	8 (40.0)	0.29
Glucose, mg/dL	153 (126–167)	186 (159–223)	0.03
Glucose >180 mg/dL	0	12 (60.0)	0.01
MABP, mmHg	121 (106–127)	118 (104–124)	0.65
MABP >120 mmHg	3 (50.0)	8 (40.0)	0.66
Pulse pressure	51.0 (29.0–55.2)	68.0 (48.8–93.8)	0.02
ICH volume, cm³	115 (80.0–139)	102 (70.8–160)	0.95
ICH location			
Right hemisphere	5 (83.3)	8 (40.0)	0.06
Lobar, (n = 9)	4 (44.4)	5 (55.6)	0.06
BG or thalamic, (n = 17)	2 (11.8)	15 (88.2)	
Any IVH	5 (83.3)	18 (90.0)	0.65
Extensive IVH	3 (50.0)	15 (75.0)	0.50
Signs of mass effect			
Cisterns effaced	2 (33.3)	10 (50.0)	0.47
Midline shift	5 (83.3)	20 (100)	0.06
Uncal herniation	3 (50.0)	15 (75.0)	0.24
Surgical decompression	5 (83.3)	1 (5.0)	<0.001
Withdrawal of support	0	14	<0.001

One patient was transferred to another acute care facility. The outcome is not known, so the patient was excluded from the analysis. Continuous variables expressed as median and interquartile range; categorical variables expressed as n (%). Continuous variables compared using the Mann-Whitney *U* test; dichotomous or categorical variables compared using χ^2.

SNF = skilled nursing facility; GCS = Glasgow Coma Scale; MABP = mean arterial blood pressure; ICH = intracerebral hemorrhage; BG = basal ganglionic; IVH = intraventricular hemorrhage; extensive IVH = blood within two or more chambers.

There were 27 such patients in our cohort; 18 (66.7%) died prior to discharge. Support was withdrawn in 66.7% (12/18) of the patients who died. Of the survivors, 66.7% (6/9) were discharged to rehabilitation, 22.2% (2/9) were discharged to a skilled nursing facility, and 11.1% (1/9) was transferred to another medical facility and excluded from further analysis. Univariate predictors of discharge to rehabilitation or better in our patients with ICH volume >60 cm³ and GCS score ≤8 are presented in table 2. Multivariate analysis was not done because of the small number of survivors (n = 9).

A total of 51 surveys were mailed to neuroscience faculty and house staff; 31 were returned (eight from neurologic surgery, 23 from neurology). There were no significant differences in the answers to general questions about futility of care based on departmental affiliation or level of experience. The level of function felt worthy of salvage was a mRS score of 4.0 (median and range, 3.0 to 4.0) (moderately severe disability; unable to walk without assistance and unable to attend to bodily needs without assistance). The majority of respondents (87.1%) stated that they use specific criteria in making the decision to withdraw support; of those who answered the question, 27 (93.1%) stated that they use the clinical condition, 24 (82.8%) the radiographic findings, 22 (78.6%) medical comorbidities, 22 (75.9%) patient age, and 18 (64.3%) the affected hemisphere. Of the prognostic variables, the lowest GCS score felt compatible with meaningful survival was 6.5[4-8] and the largest hemorrhage felt compatible with meaningful survival was 30 to 60 cm (75.0%). The majority of respondents (16/31) refused to specify an age they felt to be incompatible with meaningful survival; those that did provide an age stated that it was 70 (70 to 85) years. Of the radiographic findings probed, uncal herniation was used by 24 (77.4%) respondents, midline shift by 23 (74.2%), and intraventricular hemorrhage by 19 (61.3%) in making a decision about level of care.

Responses to questions about the cases are summarized in table 3.

Case reports. *Patient 1.* The patient was a 58-year-old woman with a history of diabetes mellitus who was found unresponsive. She was intubated and transported to the hospital. CT scan revealed a 74-cm³ left parieto-occipital hemorrhage with extensive IVH. There was no midline shift. GCS score was 8T.

Table 3 *Response to case management survey*

Question	Entire cohort	Specialty: Neurology, n = 23	Specialty: Neurosurgery, n = 8	*p* Value	Experience: Attending, n = 14	Experience: Resident, n = 17	*p* Value
Rank							
Attending	14 (44.2)	11 (47.8)	3 (37.5)				
Resident	17 (54.8)	12 (52.2)	5 (62.5)				
Case 1, n = 26							
Do surgery	7 (22.6)	3 (13.0)	4 (50.0)		4 (28.6)	3 (17.6)	
Consider surgery	12 (38.7)	9 (39.1)	3 (37.5)		3 (21.4)	9 (52.9)	
Offer only medical therapy	8 (25.8)	8 (34.8)	0		4 (28.6)	4 (23.5)	
Withdraw support	1 (3.2)	0	1 (12.5)		1 (7.1)	0	
Withdraw vs other response				0.11			0.24
Surgery vs other response				0.05			0.38
Case 2, n = 26							
Do surgery	10 (32.3)	6 (26.1)	4 (50.0)		4 (28.6)	6 (35.3)	
Consider surgery	1 (3.2)	1 (4.3)	0		0	1 (5.9)	
Offer only medical therapy	8 (25.8)	6 (26.1)	2 (25.0)		4 (28.6)	4 (23.5)	
Withdraw support	9 (29.0)	7 (30.4)	2 (25.0)		4 (28.6)	5 (29.4)	
Withdraw vs other response				0.61			0.91
Surgery vs other response				0.32			0.82
Case 3, n = 25							
Do surgery	5 (16.1)	1 (4.3)	4 (50.0)		2 (14.3)	3 (17.6)	
Consider surgery	1 (3.2)	1 (4.3)	0		1 (7.1)	0	
Offer only medical therapy	7 (22.6)	5 (21.7)	2 (25.0)		4 (28.6)	3 (17.6)	
Withdraw support	14 (45.2)	12 (52.2)	2 (25.0)		4 (28.6)	10 (58.8)	
Withdraw vs other response				0.07			0.18
Surgery vs other response				<0.01			0.97
Case 4, n = 26							
Do surgery	7 (22.6)	4 (17.4)	3 (37.5)		3 (21.4)	4 (23.5)	
Consider surgery	0	0	0		0	0	
Offer only medical therapy	5 (16.1)	3 (13.0)	2 (25.0)		2 (14.3)	3 (17.6)	
Withdraw support	16 (51.6)	13 (56.5)	3 (37.5)		7 (50.0)	9 (52.9)	
Withdraw vs other response				0.18			0.91
Surgery vs other response				0.33			1.00

Categorical values expressed as n (%) and compared using χ^2. Numbers may not total 31 because some respondents may have refused to answer the question.

Response. There was a trend toward more surgeons opting for surgical decompression; there were no significant differences in responses based on level of experience. Only one respondent felt that withdrawal of support was warranted.

Actual course of action. The patient received aggressive medical, but not surgical, therapy. She experienced numerous complications. At 6-week follow-up, mRS score was 5.

Patient 2. The patient was a 32-year-old woman with a history of substance abuse who was found unconscious. CT scan revealed a 139-cm^3 hemorrhage centered in the right centrum semiovale with 20-mm midline shift; the cisterns were effaced and uncal herniation was present. There was no IVH. GCS score was 6T.

Response. There were no significant differences in responses based on departmental affiliation or level of experience. Nearly one third of respondents stated that they would withdraw support.

Actual course of action. The patient was taken to the operating room for emergent evacuation of the hemorrhage. At 6-week follow-up, mRS score was 3.

Patient 3. The patient was a 75-year-old woman found unconscious. Medical history was notable for coronary artery disease and breast cancer. Initial CT scan revealed a 139-cm^3 ICH in the right frontal lobe with 10-mm subfalcine shift. Intraventricular blood was present; GCS score was 7.

Response. Almost 50% of respondents stated that they would withdraw support; there was a trend for more neurologists to opt for withdrawal of support. Significantly more neurosurgeons stated that they would offer surgical decompression. There were no differences in responses based on level of experience.

Actual course of action. The patient was taken to the operating room approximately 48 hours after admission for evacuation of the hemorrhage. At 6-week follow-up, mRS score was 3.

Patient 4. The patient was a 42-year-old woman who experienced the acute onset of left hemiparesis followed by obtundation. Her medical history was notable for alcohol and IV drug abuse. She recently underwent mitral and aortic valve replacement and was taking warfarin. Initial CT scan revealed a 103-cm^3 right frontal ICH with extensive intraventricular extension, 9-mm midline shift, and uncal herniation. GCS score was 3T.

Response. Slightly more than 50% of respondents stated that they would withdraw support; there were no differences based upon department affiliation or level of experience.

Actual course of action. The patient underwent emergent evacuation of the hemorrhage. Her neurologic examination improved; she opened her eyes, followed commands, and moved her right side. On the third day after surgery, transesophageal echocardiography revealed a large mitral valve vegetation and mitral insufficiency. She underwent mitral valve replacement 7 days after admission. At 6-week follow-up, mRS score was 3.

Discussion. The decision to withdraw medical support and life sustaining therapies is often made when patients with devastating neurologic injuries are expected to have a "poor outcome." The decision is usually made by a spouse or first-degree relative, as very few patients have written advanced directives.[14] What constitutes a "poor outcome," or an outcome in which continued aggressive therapy would be considered "futile," is difficult to adequately define. The definition of futility is most complicated and controversial when applied to the patient with brain-injury. A recent editorial in the *New England Journal of Medicine* highlighted the concept and controversies of futility.[15]

Withdrawal of life-sustaining therapy occurred in the majority of the patients who died in our series. Our patient data reveal that the decision to withdraw support is generally made very early after hospital presentation, as the median time from presentation to death was 2 days. In a study probing issues surrounding withdrawal of support in the neurologic intensive care unit (including but not limited to patients with ICH), 17% of surrogate decision makers felt that the timing of the first decision to withdraw life support was premature.[14] The study also found that the time from terminal extubation to death was relatively short, on the order of 7.5 hours.[14] Thus, once the decision to withdraw support is made, the anticipated outcome is quickly realized.

Models that predict outcome in ICH attempt to define futility of care based on empiric data. These data can predict the overall outcome of a cohort of patients, but not the outcome of an individual patient. In our survey, most physicians appeared to rely upon the volume of ICH and the GCS, as previously delineated,[1] in their decision-making process. In our cohort of patients, support was withdrawn more frequently in those with lower GCS score and larger hemorrhages. The patient outcome data, however, suggest that these criteria may be overly pessimistic in predicting outcome. This fact is underscored by the number of patients with ICH volume >60 cm^3 and GCS score ≤ 8 who not only survived their hospitalization, but achieved functional independence (mRS = 3). This outcome seemed to be associated with the decision to perform a surgical decompression (and therefore, not to withdraw support). Not surprisingly, the results of our survey suggest that neurosurgeons tend to be more aggressive in their approach to patients with ICH than neurologists; surgeons consider surgery earlier and more often than neurologists (although the statistical power is limited by the small number of responses). Practitioners from both specialties and at all experience levels expressed the concern that the questions and cases presented in the survey seemed to suggest that the physician was the sole decision maker in determining level of care, yet in practice decisions are made collaboratively with the patient and their family.

Most importantly, our data show how the decision to withdraw medical support can affect prognostic models, because the withdrawal of support proved to be uniformly fatal and the decision to withdraw support negated all previously identified clinical and radiographic prognosticators of outcome. At our institution, patient age seemed to influence the level of care; there was a trend for support to be withdrawn more commonly in older patients while younger patients were operated on more frequently than older patients. Support was infrequently withdrawn from those undergoing surgery. The majority of the survey respondents stated that age was a factor in the decision to withdraw support, but most refused to identify an age or age range at which their attitudes about the level of care changed.

What constitutes an acceptable quality of life can only be determined by the individual whose life is being examined. The clinicians surveyed in this study felt that if a patient could possibly recover to a mRS score of 4, aggressive therapy was warranted. Several studies, however, show that many individuals consider major stroke to be an outcome worse than death.[16,17] The clinical scenario created by catastrophic neurologic illness differs from that associated with other medical illnesses because the affected patients can no longer participate in the decision-making process about their life. The decision to withdraw medical support is obviously not a unilateral decision made by the treating physician, nor is it a decision made by family members in a vacuum. The family usually acts on behalf of the patient, based upon knowledge of that patient's desires, either explicitly or implicitly expressed. Lacking experience or a medical background, the family will depend on the judgment of the treating physician regarding potential neurologic outcomes. Thus, any biases that the physician may harbor could influence the decision to withdraw support, and therefore, outcome. That physician bias about the quality of life exists is illustrated by the fact that left hemispheric hemorrhages were operated on less frequently than right hemispheric hemorrhages. Furthermore, most clinicians surveyed stated that the affected hemisphere influenced their decision about level of care, suggesting that there is a bias toward intact language abilities as a necessary prerequisite for a meaningful neurologic outcome. And despite poor outcome in patients requiring intubation and mechanical ventilation for stroke, most families that opted for aggressive therapy stated that they would opt for aggressive therapy if the situation presented itself again.[18]

Most studies have found both GCS score and hematoma volume to be independent predictors of outcome,[1,2] but GCS appeared to be more predictive in our patient population. In another single-center study of patients undergoing endotracheal intubation for stroke (ischemic and hemorrhagic), GCS score was also found to be the only traditionally examined variable predictive of outcome.[19] GCS score and hematoma volume are highly correlated, just like midline shift, cisternal effacement, and uncal herniation. Of the CT variables reflecting the presence of mass effect, midline shift seemed most predictive of outcome, and if one uses midline shift as the sole CT indicator of mass effect, both GCS score and hematoma volume were predictive of outcome in our study. Our patient population differed from those in other studies, not only because of the relatively small number of cases, but because our outcome measure was survival to hospital discharge instead of 30-day survival, or survival thereafter.[1,2] Our patient population also differed from others studied in that a large proportion of patients underwent surgical decompression, a procedure that is usually sufficient to prevent herniation and death, at least in the immediate postoperative period. This last fact underscores the differences in approach to the patient with ICH from institution to institution; our data also showed that there is a great degree of variability that occurs within a single institution.

The interpretation of this study is limited due to its retrospective nature. Our findings, however, highlight the difficulty of modeling outcome in ICH when withdrawal of support is allowed in the population being studied and surgery is performed in a nonrandom fashion. The only unbiased way to model outcome in ICH is through a prospective study in which all patients receive equivalent care; i.e., withdrawal of support is not allowed and surgery is either offered to no one or to everyone using predefined criteria. Such a study, however, would be unethical as it would likely show disregard for patient and family wishes.

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