ORIGINAL ARTICLE

Predicting Final Disposition after Stroke using the Orpington Prognostic Score

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ABSTRACT: ***Background:*** Prediction of outcome after stroke is important for triage decisions, prognostic estimates for family and for appropriate resource utilization. Prognostication must be timely and simply applied. Several scales have shown good prognostic value. In Calgary, the Orpington Prognostic Score (OPS) has been used to predict outcome as an aid to rehabilitation triage. However, the OPS has not been assessed at one week for predictive capability. ***Methods:*** Among patients admitted to a sub-acute stroke unit, OPS from the first week were examined to determine if any correlation existed between final disposition after rehabilitation and first week score. The predictive validity of the OPS at one week was compared to National Institute of Health Stroke Scale (NIHSS) score at 24 hours using logistic regression and receiver operator characteristics analysis. The primary outcome was final disposition after discharge from the stroke unit if the patient went directly home, or died, or from the inpatient rehabilitation unit. ***Results:*** The first week OPS was highly predictive of final disposition. However, no major advantage in using the first week OPS was observed when compared to 24h NIHSS score. Both scales were equally predictive of final disposition of stroke patients, post rehabilitation. ***Conclusions:*** The first week OPS can be used to predict final outcome. The NIHSS at 24h provides the same prognostic information.

RÉSUMÉ: Prédiction de l'issue finale après un accident vasculaire cérébral au moyen du Orpington prognostic score et du NIHSS. ***Introduction :*** La prédiction de l'issue après un accident vasculaire cérébral (AVC) est importante pour le triage des patients, l'établissement d'un pronostic pour les familles et l'utilisation appropriée des ressources. Un pronostic doit être établi en temps opportun et le test utilisé doit être simple d'application. Plusieurs échelles ont démontré une bonne valeur pronostique. À Calgary, le Orpington prognostic score (OPS) est utilisé pour prédire l'issue afin d'aider au triage en vue de la réhabilitation. Cependant, son utilité comme outil de prédiction une semaine après l'AVC n'a pas été évaluée. ***Méthodes :*** L'OPS une semaine après l'AVC de patients admis à une unité sub-aiguë d'AVC a été examiné pour déterminer s'il était corrélé à l'issue finale après la réadaptation. La valeur prédictive de l'OPS évalué une semaine après l'AVC a été comparée au score du NIH Stroke Scale (NIHSS) évalué 24 heures après l'AVC au moyen de l'analyse de régression logistique et de l'analyse de type ROC. L'issue primaire était l'issue au moment du congé de l'unité d'AVC si le patient allait directement à la maison ou s'il mourait, ou du congé de l'unité de réadaptation. ***Résultats :*** La première semaine, le OPS était fortement prédictif de l'issue finale. Cependant, aucun avantage important n'a été noté par rapport au score NIHSS à 24 heures de l'événement. Les deux échelles prédisaient aussi bien l'issue finale de ces patients après la réadaptation. ***Conclusions :*** Le OPS une semaine après l'AVC peut être utilisé pour prédire l'issue finale. Le NIHSS après 24 heures fournit la même information pronostique.

Can. J. Neurol. Sci. 2004; 31: 494-498

Early identification of the functional outcome of stroke survivors after rehabilitation may promote the most efficient use of hospital resources.[1] It may also allow maximum potential for patient recovery.[2]

Rehabilitation of stroke patients is time consuming and costly. Therefore, early identification of stroke patients in need of long-term care (LTC) and rehabilitation may promote better hospital resource use.[3] Stroke severity is the most important prognostic variable because it is predictive of outcome on multiple levels including length of hospital stay, recovery, and ultimately, functional outcome.[4-6]

There are numerous impairment scales available for clinical practice and research use.[5,7,8] The Orpington Prognostic Score (OPS) [Appendix 1] is a relatively new tool for stroke assessment among rehabilitation staff although it is not widely known among neurologists or physiatrists. This scale is currently

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RECEIVED SEPTEMBER 5, 2003. ACCEPTED INFINALFORM MAY 6, 2004.

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in use in Calgary. The OPS is a modification of the Edinburgh score[1] to which a cognitive impairment domain has been added. The OPS has scores ranging from 1.6 as the best score to 6.8 as the worst, and may further categorize stroke deficits as minor (<3), moderate (3-5), or severe (>5).[1,9] In two separate cohorts, the OPS has been shown to be reliable and to show excellent predictive value at three months and six months post stroke.[10,11] Kalra and Crome[9] concluded that the OPS was a better predictor of outcome in the elderly when compared to the Edinburgh or Barthel Activities of Daily Living Score for 14-week post stroke activities. The OPS was found to be a primary score for rehabilitation and targeting of therapy resources rather than an acute prognosis score.[12] The OPS is simple to use and can be learned with minimal training. Typically, the OPS is scored during the second week of a stroke admission.

The National Institutes of Health Stroke Scale (NIHSS) has become the standard tool for quantifying stroke-related neurological deficits at baseline and in follow-up in the stroke neurology community. It is a well-validated and psychometrically sound scale that takes the trained assessor 10 minutes to complete.[13] It has 11 domains assessing multiple facets of neurological function but is biased toward higher scores among patients with left hemisphere deficits.[14,15] Any health professional can be certified in its administration.[16,17] Medium term outcome at three months after stroke is strongly predicted by the NIHSS.[5] Individuals scoring lower than 13 had significantly better functional outcomes than those individuals who scored higher than 13 on the scale.

Previous comparison of the OPS and the NIHSS (both measured in the first two weeks) has suggested that the OPS is slightly better than the NIHSS at predicting physical functioning at six months post-stroke.[10] Conversely, others have argued that the NIHSS measured at baseline (within 24 hours of stroke onset) is similarly predictive of final hospital discharge.[18] A key issue in discharge planning is timeliness. Assessments at 14-days after stroke are not realistic given current management styles. The aim of this study was to determine the predictive value for final post-rehabilitation disposition of the OPS measured in the first week of hospital admission compared to the NIHSS score measured at 24-hours after admission.

METHODS

The Calgary Health Region serves a population of approximately one million people. Because of pre-hospital triage, 80% of stroke patients are admitted to the Foothills Medical Centre (FMC) by the acute stroke team and stroke services. A majority of these patients are admitted to the FMC Stroke Unit. Patients who are moribund or deemed palliative at admission or who have significant co-morbid conditions (e.g. moderate to severe dementia) such that they would not be expected to be able to participate in a stroke unit rehabilitation program are admitted to a general medical ward. Selected patients with transient ischemic attack (TIA) are admitted to the stroke unit for rapid investigation. These include patients with TIA within the previous 24 hours, a duration of symptoms > 5 minutes and one of following symptoms: a language disturbance, weakness in face, arm and/or leg, or amaurosis fugax/transient monocular blindness. Patients must also be in stable medical condition and must not require telemetry or arterial catheters for blood pressure monitoring. Stroke is defined as an acute focal neurological deficit lasting more than 24 hours and of vascular origin. Transient ischemic attack is defined as an acute focal neurological deficit lasting less than 24 hours and of vascular origin. Patients with intracerebral hemorrhage and venous sinus thrombosis but not subarachnoid hemorrhage are admitted to the stroke unit.

All patients in the study were admitted to the FMC Stroke Unit and were evaluated using the NIHSS by a NIH certified physician or stroke nurse practitioner both at baseline and at 24 hours. Similarly, selected patients were evaluated by rehabilitation staff (physiotherapist, occupational therapist or physiatrist and/or speech-language pathologist) and scored on the OPS within the first seven days of admission and at 14 days after admission. Referral to rehabilitation staff was dependent upon the nature of the stroke deficit. Some patients only had 14-day scores available and were not included in this analysis. However, patients who remained on the unit for 14 days or more had additional 14-day scores recorded and these were compared with the seven-day scores. Further, patients with TIA or mild strokes who were not expected to require outpatient or inpatient rehabilitation were not referred and therefore not assessed on the OPS. The OPS data were recorded prospectively in a rehabilitation database. There were no limits based upon age, location of stroke, prior dependence or disability or incident vs. recurrent stroke.

Patient flow from the Stroke Unit is shown in Figure 1. The final disposition after discharge from the hospital or from one of two rehabilitation facilities in the city was the primary outcome. Final disposition was an ordered variable with four levels: home, nursing home, hospital or deceased. The OPS was categorized into mild (<3), moderate (3-5) and severe (>5) deficits and the NIHSS score was classified into mild (0-5), mild-moderate (6-

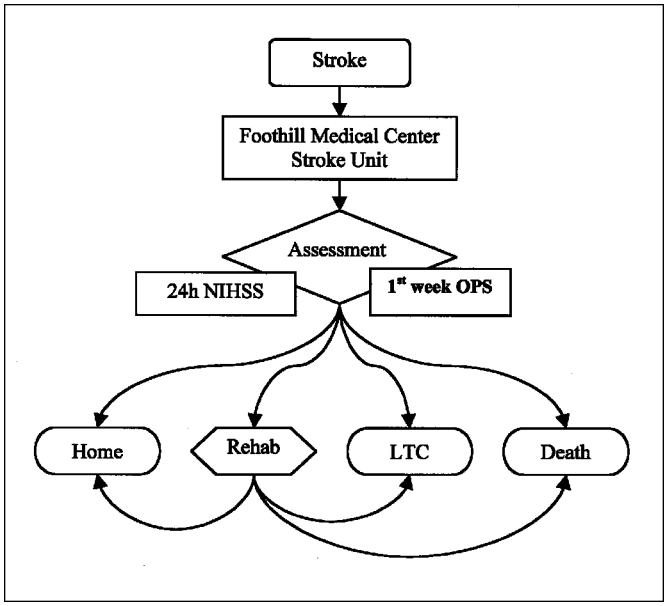

Figure 1: *Patient flow through the stroke unit to rehabilitation to final disposition.*

https://doi.org/10.1017/S0317167100003693 Published online by Cambridge University Press

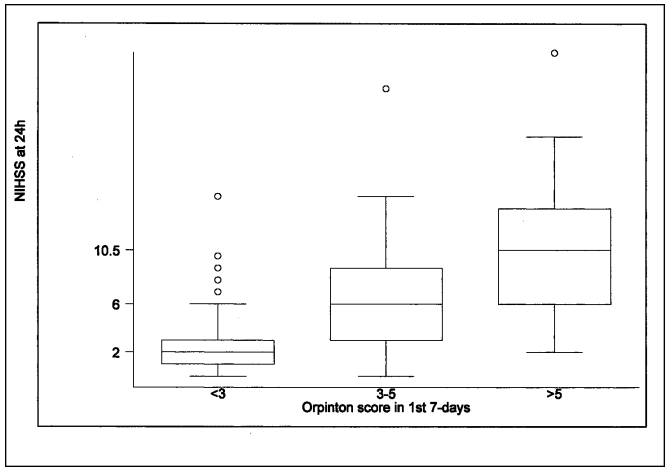

Figure 2: *Relationship between OPS at seven days and the 24 hour NIHSS score*
Box-whisker plots showing the distribution of NIHSS scores at 24h according categories of the Orpington score measured in the first seven days of admission.

10), moderate (11-15), moderate-severe (16-20) and severe (>20) stroke deficits.

Statistical methods

Data are reported using descriptive statistics. The unit of analysis was an inpatient stay on the stroke unit such that 12 patients who were admitted and discharged more than once during the study period were included more than once. Ordered logistic regression was used in two models to assess the predictive value of the first week OPS and 24-hour NIHSS scores for the final disposition of patients. Multivariable analysis was used to assess the role of potential confounding variables such as age, gender and co-morbid conditions such as diabetes mellitus. As a secondary analysis, the final disposition was dichotomized into a binary variable – home, not home and receiver-operator curves were used to illustrate the performance characteristics of each scale in predicting outcome.

Results

Among stroke unit patients who required inpatient or outpatient rehabilitation, 277 are included in this study. Demographics and stroke characteristics are shown in Table 1. The median age was 71, 51% of patients were male, and most were Caucasian (88.1%). First week OPS were recorded on 140 of these patients and it is this cohort that was used for analysis. Patients who did not have OPS recorded were more likely to be younger by a mean 3.5 years (p=0.05) but no other significant differences in baseline characteristics were observed.

The 24-hour NIHSS scores were correlated with OPS (0.604, Spearman's rho) and this relationship is illustrated in Figure 2. Ordered logistic regression in both models for OPS and for NIHSS scores, indicated that both were significant predictors of outcome. Age was additionally a significant predictor of final outcome in both models; no other variables were predictors.

Table 1: Baseline Characteristics of Study Patients

	Median or %; (n)	95%CI or IQR
Demographics		
Age (years)	70.6	60.4 - 79.8
Female gender	48.4; (134)	42.4 - 54.4
Race - Caucasian	88.1; (244)	82.9 - 91.0
Clinical		
Length of stay (days)	8	5 - 13
NIHSS - Admission	5	2 - 9
NIHSS - 24h	3	1 - 7
Historical		
Family history stroke	30.7; (85)	25.3 - 36.4
Smoker - current or past	40.4; (112)	34.6 - 46.5
Atrial fibrillation – chronic/paroxysmal	19.1; (53)	14.7 - 24.3
Hypertension	69.7; (193)	63.9 - 75.0
Past stroke/TIA	28.5; (79)	23.2 - 34.2
Hyperlipidemia	35.4; (98)	29.8 - 41.3
Diabetes	20.2; (56)	15.6 - 25.4

IQR = interquartile range; TIA= transient ischemic attack

Table 2: Probability of Final Discharge Location

	Probability (%) of Final Discharge Location			
	Home	Nursing Home	Hospital	Deceased
Orpington Model				
OPS < 3	91.6	3.4	4.8	0.2
OPS 3-5	77.2	8.3	13.8	0.8
OPS > 5	51.1	13.4	33.1	2.4
NIHSS 24h Model				
NIHSS 0-5	90.1	3.9	5.3	0.7
NIHSS 6-10	77.2	7.9	12.9	1.9
NIHSS 11-15	61.6	10.9	23.1	4.3
NIHSS 16-20	49.3	11.8	31.0	7.8
NIHSS >20	19.0	9.4	47.0	24.5

Tests of interaction between age and the OPS and age and NIHSS score at 24h were not significant. Ordered logistic regression allows estimation of the predicted proportions of patients in each final discharge category. These are presented in Table 2.

Secondary analysis using a dichotomous outcome and simply the OPS or the NIHSS score, without adjustment for age is illustrated in Figure 3. Both scales are excellent predictors of final outcome with c-statistics near 0.80. The sensitivity of both scales was low but specificity was high at 87.7% for OPS and 97.7% for the NIHSS. The OPS correctly classified 77% of patients and the NIHSS correctly classified 84% of patients. The two scores are significantly co-linear such that including the two

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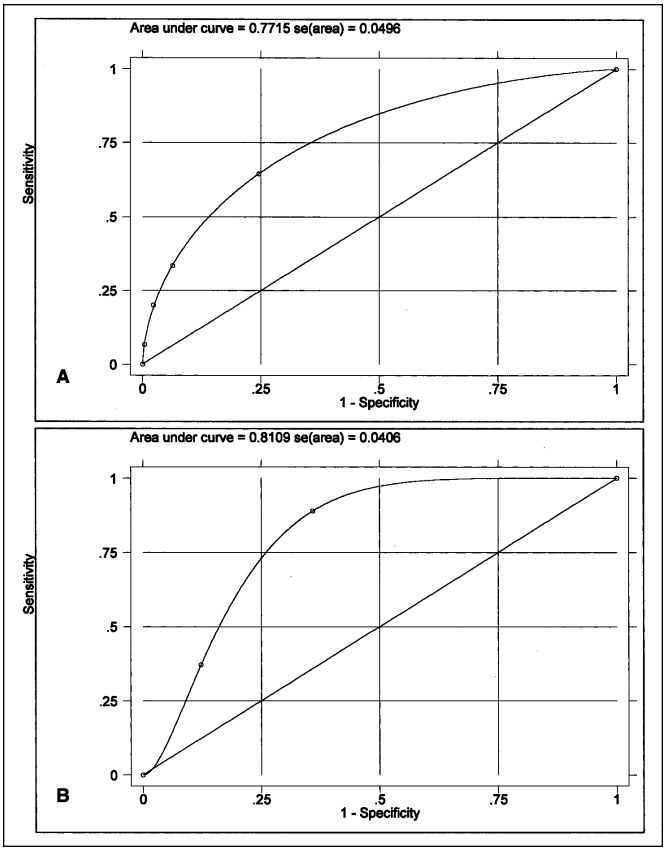

Figure 3: *Receiver operator characteristics curves for OPS and NIHSS at predicting final disposition*
Panel A demonstrates the OPS score and Panel B demonstrates the NIHSS score.

scores in a logistic model does not substantially enhance predictive power.

Among patients who had both seven-day and 14-day OPS scores (n=62) the difference between the 14-day score and the seven-day was small. A majority (73%) showed no change in score while 20% showed improvement by one or more categories and 6% worsened. The 14-day OPS score was also similarly predictive of final outcome using receiver operator characteristics curve analysis (c-statistic 0.74).

Discussion

Among a population of mild-moderately affected stroke patients, early assessment of stroke severity either by the OPS or the NIHSS scores can accurately predict the final disposition. The two scores are highly correlated which suggests that they are both measuring similar domains of function or that measured domains are highly correlated. Further, the seven-day OPS score is worse than the 14-day score in about 20% of patients with a majority showing no change in score category.

It is noteworthy that neither scale was good at predicting outcome among patients with severe stroke. This did not improve with the 14-day score. Nearly half of patients with severe stroke (NIHSS > 15 or OPS > 5) were at home at final discharge. This suggests that other domains of function become increasingly important as stroke severity increases. The emergence of post-stroke dementia is a possible explanatory factor and an hypothesis to be explored. Other studies have used multivariable models to predict stroke outcome including analysis of imaging and the change in status over the first week, but only marginally improved upon predictive accuracy.[19] As in other prior studies, this conclusion is limited because very few of our patients were badly disabled at 24 hours (n = 6 for NIHSS >15). Conversely, both scales showed excellent discriminative value for patients with milder stroke emphasizing that with mild to moderate deficits, stroke severity predicts much or all of the variance in final outcome but this effect wanes as stroke severity increases.

Importantly, both scales can be scored early in the hospital course with preserved predictive value. This should allow confidence for the treating physicians and rehabilitation staff to make accurate predictions about the expected long-term outcome and to proceed accordingly. Our study does not assess the appropriateness of the triage decision to rehabilitation and it is less clear how the scores can be used for this purpose. For patients with moderate to severe stroke, final outcome is almost certainly dependent upon in-patient stroke rehabilitation.

In conclusion, both scales reliably predict outcome after stroke, probably because stroke severity is the most important determinant of outcome. The OPS is simple to use and learn and does not have standardized certification. It may be performed at seven days with similar predictive value to the 14-day score. The NIHSS has become the global standard for the assessment of stroke deficits facilitating comparisons across cohorts and populations worldwide. Additionally, certification is relatively easy. Although either scale can be used to predict outcome in typical hospital practice, we would encourage the use of the NIHSS because it has become the global standard.

Acknowledgements and Funding

This project was supported in part by the Heart & Stroke Foundation of Alberta/NWT/NT and the Calgary Health Region.

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Appendix 1 – Orpington Scale (Modified Edinburgh Scale)

A. Motor deficit in arm

Lying supine, patient flexes shoulder at 90° and resists.

0.0 = MRC grade 5 (normal power)
0.4 = MRC grade 4 (diminished power)
0.8 = MRC grade 3 (anti-gravity strength only)
1.2 = MRC grade 1-2 (movement with gravity eliminated or trace movement)
1.6 = MRC grade 0 (no movement)

B. Proprioception (eyes closed)

Locates affected thumb:

0.0 = Accurately
0.4 = Slight difficulty
0.8 = Finds thumb via arm
1.2 = Unable to find thumb

C. Balance

0.0 = Walks 3 meters without help
0.4 = Maintains standing position, unsupported for 60 seconds
0.8 = Maintains sitting position
1.2 = No sitting balance.

D. Cognition

Hodgkinson's mental test: score one point for each correct answer.

a. _____ Age of patient
b. _____ Time (to nearest hour)
"I am going to give you an address to remember. Please remember it as I will ask you later. 42 West Street."
c. _____ Name of hospital
d. _____ Year
e. _____ Month
f. _____ Years of the Second World War
g. _____ Name of President/Prime Minister
h. _____ Count backwards from 20 …1
i. _____ What is the address I asked you to remember?

0.0 = Mental test score of 10
0.4 = Mental test score of 8-9
0.8 = Mental test score of 5-7
1.2 = Mental test score of 0-4

TOTAL SCORE: 1.6 + Motor + Proprioception + Balance + Cognition

https://doi.org/10.1017/S0317167100003693 Published online by Cambridge University Press