EMOTIONAL REACTIONS following stroke have been noted for some time, and recent studies have confirmed the presence of depression in between 30-60% of all stroke patients. Robinson and his colleagues have systematically studied this phenomenon. Their work and that of others suggests that post-stroke depression may represent more than a simple reaction to the accompanying functional impairment, that such depression has features similar to those of major depressive episodes, and that its severity appears to be related to the intrahemispheric location of the brain lesion, and that the etiology and prevalence of depression may vary at different points during the recovery period. There is also conflicting evidence about differences in the relative severity of depression associated with hemispheric side of the lesion.

Many issues remain regarding the phenomenon of post-stroke depression. One of the most important is the potential negative impact of depression on patient participation in the rehabilitation process and the associated rehabilitation outcome. In particular, it is of interest to assess the impact of depression during the subacute phase of recovery when rehabilitation efforts are thought to be most critical in determining outcome.

The present study was designed to examine relationships between post-stroke depression, functional status, and rehabilitation outcome. Patients admitted to a rehabilitation program for recent first stroke were evaluated for depression through self-report measures and staff ratings. Patients also rated the particular coping strategies which they used in dealing with their illness and hospital stay. Physical and occupational therapists provided measures of functional impairment at admission and discharge. A high (47%) prevalence of depression was found in this population, with no overall differences observed between patients with right or left hemisphere lesions. Depressed patients, in comparison to non-depressed, evidenced greater functional impairment at both admission and discharge. However, both groups showed similar gains over the course of rehabilitation. Coping strategies employed by depressed patients appeared to reflect a lower level of participation in the rehabilitation process. A subgroup of patients evaluated 6 weeks after discharge revealed that depression was associated with a worsening on one measure of functional status. These findings indicate that depression is a frequent companion of stroke, that it is associated with degree of functional impairment, and that it may exert a negative impact on the rehabilitation process and outcome.

**Method**

**Patient Population**

Eligible patients were screened from 166 consecutive admissions, with the diagnosis of stroke, to a 120-bed rehabilitation hospital. Screening allowed the exclusion of patients with potentially complicating medical conditions (e.g., previous myocardial infarct, recent major surgery, n = 24), receptive aphasia or comprehension problems (n = 23), previous stroke (n = 19), age greater than 85 years (n = 8), foreign language (n = 8), and those with previous psychiatric history (n = 4) or current intake of antidepressant medication (n = 8). An additional 8 eligible patients refused to participate, leaving 64 patients in the final sample. This group included 35 patients with lesions in the right hemisphere and 29 with lesions in the left hemisphere, with the etiology for stroke being primarily thrombotic.
Procedures

Informed consent for all phases of the study was obtained from both the patient and the attending physician within one week of admission. Consent included access to medical files, an interview in which psychological inventories were administered, and computerized tomography (CT) of the brain.

In order to control for diurnal variations in mood, all psychological testing was conducted between 10 AM and 3 PM. Psychological questionnaires were administered in a standardized interview format, with response cards to which patients could respond by pointing provided for patients with expressive aphasia. Staff ratings of depression were obtained from the patient's primary nurse within two days of the psychological interview. CT scans were conducted within 2 weeks of the interview, and were analyzed for lesion volume and location using a previously described protocol. Ratings of functional status were completed by physical therapy and occupational therapy staff within 1 week of admission and at discharge.

Depression Measures

Zung Self-rating Depression Scale (SDS). The SDS is a 20-item* form which requires the patient to indicate, on a 4-point scale, how frequently certain affective, psychomotor, physiological and cognitive symptoms manifest themselves.14

Beck Hopelessness Scale (BHS). The BHS consists of 20 items in a true-false format, reflecting pessimism or negative expectancies concerning oneself and one's future life.15 Scores of 10 or more on this scale have been associated with significant suicide risk.16

Hopkins Symptom Checklist (HSCL). The HSCL consists of 58 symptoms for which the patient indicates, on a 4-point scale, the degree of distress associated with each.17 The present report is limited to the results for the depression subscale (HSCL-D).

Composite Depression Index (CDI). A composite depression score was computed by translating the SDS, BHS, and HSCL-D to ordinal scales. Each measure had 5 intervals within which an approximately equal number of scale scores fell. These three converted scores were summed such that there was a minimum score of 3 and a maximum of 15 possible for each patient. This procedure of combining scores from several measures of depression is similar to that employed by Robinson and colleagues.8

Nurses' Rating Scale (NRS). This scale was developed by Robinson and his co-workers specifically for use in assessing depressive symptoms in stroke patients. The scale consists of 25 items, rated on a 4-point scale, reflecting different aspects of patient behavior on the ward. Items relating to patient's verbal communication were not included in the following analyses, given the difficulty reported by nurses in rating patients with aphasia.

Coping Measures

Coping Scale (COPE). This 20-item scale is derived from a coping checklist developed by Billings and Moos.18 Kaloupek et al19 modified the original version to make it suitable for application during a blood donation procedure. The present version involved additional changes to three items in order to make the content suitable for hospitalized patients. Given general similarity with the Kaloupek et al form, five factors identified by them were examined by using the sum of items endorsed on each factor as the factor score. These factors were labeled: Worry (e.g., I prepare for the worst), Suppression (e.g., I try to reduce tension by not thinking about the situation), Behavioral Action (e.g., I take some positive action to regain strength), Rational Cognition (e.g., I take things one step at a time), and Denial (e.g., I keep my feelings to myself).

Health Locus of Control Scale (HLC). The health locus of control scale was used to assess individual differences and expectancies related to specific influences determining personal health. The scale consists of 11 items in a true-false format, with high scores indicative of an individual who anticipates very little control over determination of health related outcomes.20

Functional Evaluations

Physiotherapy (PT) and occupational therapy (OT) staff rated the functional status of patients at admission and discharge on 20 items from the Patient Evaluation Conference System (PECS; 21). The selected items had been modified to render them more appropriate for stroke patients. This scale provided a PT index for overall level of motor function (e.g., ambulation, sitting balance) and an OT index for capacity for independent living (e.g., feeding, dressing). Ratings were made on 7-point scale, with a score of 1 indicating complete dependence for function and 7 indicating independent function. PT and OT staff were kept blind with regard to all interview data.

In addition to the in-hospital evaluations, a subset of patients returned to the hospital for follow-up assessments 6 weeks after discharge. These data were available for only 25 patients due to scheduling and transportation problems or to discharge of patients to general hospital or chronic care institutions.

Results

Prevalence of Depression

Moderate to severe depression22 was found in 22% of all patients (SDS score greater than or equal to 60), with 25% of patients reporting mild depressive symptoms (SDS score between 50–59). Significant hopelessness16 was reported by 16% of all patients (BHS score of 10 or more). T-test analyses also indicated that right and left hemisphere patient groups did not differ on any of the dependent measures, except the HSCL-D

*One item on the SDS, "I feel others would be better off if I were dead", was deleted for the purposes of this study on the basis of pilot work that indicated an unduly negative emotional reaction in some patients. The score on this modified 19-item version was prorated to yield a total score equivalent to the 20-item form.
scale, on which right hemisphere patients had higher scores ($p < .05$).

**Correlational Analyses**

Pearson product-moment correlations were initially computed among the different measures of depression. Self-report (SDS, BHS, HSCL-D) measures of depression were significantly correlated with each other ($r = +.48$ to $+.66$, $p < .01$), but only the HSCL-D scale was correlated with NRS ratings ($r = +.31$, $p < .05$).

Correlation coefficients computed between the three self-report measures of depression and the two measures of functional status at admission revealed no significant relationships. In contrast, scores on the NRS were negatively correlated with both PT ($r = -.45$, $p < .01$) and OT ($r = -.36$, $p < .01$) ratings, indicating that patients rated by nursing staff as relatively more depressed showed relatively greater functional impairment. Correlations between depression scores and discharge functional status revealed no significant relationships. As well, depression scores were not related to changes in functional status from admission to discharge, nor were they related to length of stay.

Correlation coefficients computed between depression measures and coping variables revealed that depression was associated with less endorsement of both behavioral action (SDS: $r = -.26$, $p < .05$) and rational cognition (CDI: $r = -.27$, $p < .05$) strategies. This finding is consistent with the decreased activity and negative cognition that characterize depression. As well, a significant positive correlation between the BHS and HLC ($r = +.40$, $p < .01$) indicated that hopelessness was associated with the perception that the illness and related circumstances were largely determined by external factors.

Finally, no relationships were found between use of particular coping strategies and change in functional status from admission to discharge, or between these strategies and length of stay.

**Comparison of Depressed and Non-depressed Patients**

Patients next were divided into depressed and non-depressed groups on the basis of SDS scores less than 50 (normal) or greater than or equal to 50 (mild to severe depression). As can be seen in table 1, there were no differences between groups on age, sex, side of lesion, time since stroke, length of stay, lesion volume or lesion location. As expected, however, there were differences on all depression measures, and depressed patients tended to score lower on the Behavioral Action and Rational Cognition factors.

Figure 1 presents PT and OT functional status scores for depressed and non-depressed groups at admission and discharge. Analyses of variance (Group × Time), with repeated measures (admission and discharge) conducted on the Time factor, revealed significant main effects for Group and Time, for both PT (Group: $F(1,52) = 4.18$, $p < .05$; Time: $F(1,52) = 47.43$, $p < .01$) and OT ratings (Group: $F(1,46) = 4.93$, $p < .05$; Time: $F(1,46) = 72.35$, $p < .01$). Thus, overall, depressed patients had lower functional status scores than did the non-depressed. Both groups improved in functional status from admission to discharge, but the failure to observe significant Group × Time interactions confirmed that groups did not differ in the degree of improvement over the course of rehabilitation.

**Follow-up**

Evaluation of functional status for the 25 patients on whom 6-week follow-up data were available was based on the functional score at discharge subtracted from the score at follow-up. This difference score was calculated for both PT and OT ratings. Patients were divided into depressed ($n = 10$) and non-depressed ($n = 15$) groups, as described earlier. T-tests revealed no significant group differences on changes in OT ratings. However, on PT ratings, the depressed patients showed reductions ($X = -0.42 ± 0.50$) in functional status significantly different ($p < .02$) than the relative stability shown by the non-depressed group ($X = 0.1 ± 0.3$). This association between depression and loss of functional status was also evident in correlational analyses ($r = -0.61$, $p < .01$), and a scatterplot depicting this relationship is presented in figure 2. As can be seen, SDS scores below 50 were generally associated with slight increases or no change in functional status, whereas scores above 50 were associated with marked reductions in functional status.

**Discussion**

The present findings indicate that depression is a frequent companion of stroke. Almost half of all patients scored above the cutoff for significant depression, and significant hopelessness was reported by approximately one-third of these patients. This high prevalence rate is consistent with previous reports. Comparisons between depressed and non-depressed patients indicated that depression was associated with greater functional impairment at both admission and discharge. These data appear to be inconsistent with previous studies reporting weak or no association between depression severity and functional impairment. This discrepancy may be due to the use of correlational analyses in the previous studies, given that correlational analyses conducted on the present data similarly failed to reveal significant associations. Such analyses treat all scores on depression measures as quantitatively related to depressed mood, even

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1. The construct and criterion-related validity of the latter measures was suggested by a strong correlation between them ($r = 0.68$, $p < .01$), and by good prediction of length of stay ($r = -.52$ (PT); $r = -.46$ (OT), both $p < .01$).

2. Comparisons were made between this group and the larger sample in order to address the possibility that patients on whom follow-up data were available represented a select sample. T-test analyses revealed no differences on patient demographics or on any of the dependent measures, including functional impairment at admission or discharge.
TABLE 1  Means and Standard Deviations for Demographic, Depression, Coping, and Neuronalatomical Measures for Depressed and Non-depressed Patients

<table>
<thead>
<tr>
<th>Measures</th>
<th>Depressed (n = 30)</th>
<th>Non-depressed (34)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient characteristics</td>
<td></td>
<td></td>
</tr>
<tr>
<td>age</td>
<td>68.8±9.3</td>
<td>65.7±8.0</td>
</tr>
<tr>
<td>sex (% Male)</td>
<td>53%</td>
<td>68%</td>
</tr>
<tr>
<td>side of lesion (% Right)</td>
<td>60%</td>
<td>50%</td>
</tr>
<tr>
<td>time since stroke (Days)</td>
<td>58.6±20.5</td>
<td>55.5±30.0</td>
</tr>
<tr>
<td>length of stay (Days)</td>
<td>77.4±46.1</td>
<td>74.8±43.2</td>
</tr>
<tr>
<td>Depression Inventories</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zung Depression Scale</td>
<td>59.9±7.7</td>
<td>39.5±7.42</td>
</tr>
<tr>
<td>Beck Hopelessness Scale</td>
<td>7.9±2.9</td>
<td>4.6±3.33</td>
</tr>
<tr>
<td>Hopkins Symptom Checklist</td>
<td>19.1±5.3</td>
<td>12.5±3.22</td>
</tr>
<tr>
<td>(Depression Subscale)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Composite Depression Index</td>
<td>11.5±2.0</td>
<td>6.5±2.33</td>
</tr>
<tr>
<td>Nurses’ Rating Scale</td>
<td>27.6±6.1</td>
<td>24.6±4.67</td>
</tr>
<tr>
<td>Coping Measures</td>
<td></td>
<td></td>
</tr>
<tr>
<td>cope scale</td>
<td></td>
<td></td>
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<tr>
<td>worry</td>
<td>4.3±1.7</td>
<td>4.2±1.3</td>
</tr>
<tr>
<td>suppression</td>
<td>3.1±1.2</td>
<td>3.1±1.1</td>
</tr>
<tr>
<td>behavioral action</td>
<td>2.4±0.9</td>
<td>2.7±0.4*</td>
</tr>
<tr>
<td>rational cognition</td>
<td>2.3±0.9</td>
<td>2.7±0.6*</td>
</tr>
<tr>
<td>denial</td>
<td>2.8±0.7</td>
<td>2.9±0.6</td>
</tr>
<tr>
<td>health locus of control</td>
<td>5.8±1.7</td>
<td>5.2±2.1</td>
</tr>
<tr>
<td>Lesion Characteristics*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>lesion volume (% total brain volume)</td>
<td>6.1±6.5</td>
<td>4.2±4.6</td>
</tr>
<tr>
<td>distance of anterior-most point (% total AP distance)</td>
<td>30.6±20.3</td>
<td>28.1±13.2</td>
</tr>
<tr>
<td>distance of posterior-most point (% total AP distance)</td>
<td>62.6±17.6</td>
<td>53.7±14.4</td>
</tr>
</tbody>
</table>

*As the result of loss of CT data (no lesion visualizing on scan, or multiple lesions), there were only 17 depressed and 18 non-depressed patients with complete CT data.

*p < .10.
†p < .05.
‡p < .01.

when they fall within the normal range. Given evidence supporting the use of cutoff points for significant depression,16, 22 correlations may underestimate the degree of meaningful association due to the inappropriate inclusion of low scores that do not show a linear relationship with either the construct of depression or functional impairment. Comparison of depressed and non-depressed groups may therefore constitute a more appropriate approach in examining the phenomenon of post-stroke depression.

Of particular significance was the finding that depressed patients showed similar improvements in functional status following short-term rehabilitation as compared to non-depressed patients. Thus, depression did not appear to undermine the process of formal rehabilitation. However, data on a subgroup of patients who were assessed 6 weeks following discharge suggested that depression may be associated with decrements in functional status following discharge. This finding must be cautiously interpreted, given that it was seen in what may have been a select sample and on only one of the two functional status measures. Nevertheless, it suggests that depression may exert a negative impact on long-term rehabilitation outcome.

The failure to observe a clear impact of depression on change in functional status from admission to discharge, but an apparently negative effect post-discharge may be due to the equalizing effect of intensive contact. That is, while in-hospital, patients were exposed to an intensive rehabilitation program in which their participation was actively sought and reinforced. Following discharge and in the absence of this active encouragement, depression may have interfered with the patient's personal initiative to engage in the recommended therapeutic exercises and activities. This reduced activity may have resulted in a loss of the gains achieved while in-hospital.

While the preceding hypothesis is plausible, it assumes that patients who were depressed at admission remained depressed at discharge and follow-up. Unfortunately, one of the limitations of the present study...
is the absence of depression data beyond admission testing, so that it is difficult to be definitive on this point. However, it should be noted that previous work suggests that untreated post-stroke depression possesses an 8-9 month course, so that it is likely that these patients remained depressed at discharge and beyond.

The reported coping efforts associated with depression (i.e., endorsement of less rational cognitive appraisal and less behavioral action) appear to reflect characteristics that would lead to a lower level of participation in the rehabilitation process. These may be mediating features whereby depression interferes with long-term rehabilitation. In addition, individuals who had high HLC scores expressed greater hopelessness. Health locus of control has been suggested as a mediating factor in a variety of health behaviors and health outcomes, and it is conceivable that stroke patients who see their circumstances as largely determined by external forces are less likely to take an active role in their own rehabilitation.

No overall differences were found between patients with right as compared with left hemisphere lesions, although one depression measure (HSCL-D) suggested greater depression in right hemisphere patients. This unexpected finding may be spurious, given the absence of differences on the other depression measures. However, it may also be related to the necessary exclusion of patients with comprehension deficits from the sample. Since all of these patients had lesions in the left hemisphere, it is possible that their exclusion led to an underestimation of depression levels in the left hemisphere group as a whole. More generally, this and other exclusion criteria employed in the present study (e.g., accompanying medical conditions), may limit the degree to which the findings can be generalized to the full population of stroke patients.

Finally, in spite of the high prevalence of depression, only one-third of moderately to severely depressed patients in this sample were referred for treatment by mental-health professionals during their hospital stay. This low treatment rate, which is consistent with that previously reported, indicates that post-stroke depression remains largely untreated. This situation may be especially problematic for the subset of patients who also report hopelessness in the range of potential suicide risk. Our data underscore the need to sensitize rehabilitation personnel to the possible presence of depression in stroke patients, so that steps can be taken to counteract what may be serious long-term consequences of affective disturbance in these patients.

Acknowledgments

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References


FIGURE 2. Scatterplot depicting the relationship between depression scores and change in functional status as assessed by physiotherapy (PT) staff ratings, from discharge to 6-weeks post-discharge.
The EC/IC Bypass Study was a randomized trial evaluating the prophylactic value of a superficial temporal artery to middle cerebral artery (MCA) bypass in patients with TIA or non-devastating stroke due to internal carotid artery occlusion or intracranial stenosis, or MCA stenosis or occlusion. Nine patients were found to have bilateral occlusion of the MCA trunk before entering the study and were subsequently followed. This paper presents the clinical, radiologic and follow-up data of these 9 patients; to the best of our knowledge, no series of patients with bilateral MCA occlusion has been published previously.

Methods and Case Reports

Nine of 1,377 patients from the EC/IC Bypass Study were found to have bilateral occlusion of the MCA trunk, from the origin of the MCA to the origin of the first branch of trifurcation. To enter the EC/IC Bypass Study, all patients had to have had a TIA or a non-devastating stroke within three months of entry. In order to study only patients with atherosclerotic vascular disease, patients with severe strokes, fibromuscular dysplasia, arteritis, blood dyscrasia and heart disease as a cause of cerebral emboli or decreased cerebral perfusion (valvular disease, atrial fibrillation and other major arrhythmia, cardiomyopathy) were excluded. The follow-up procedure included a neurological re-evaluation every three months, with evaluation of delayed stroke, TIA, functional disability and death.
Post-stroke depression: relationships to functional impairment, coping strategies, and rehabilitation outcome.

D Sinyor, P Amato, D G Kaloupek, R Becker, M Goldenberg and H Coopersmith

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