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Research Article

Manual and Oral Apraxia in Acute Stroke, Frequency and Influence on Functional Outcome

The Copenhagen Stroke Study

ABSTRACT

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Objectives: To determine the frequency of manual and oral apraxia in acute stroke and to examine the influence of these symptoms on functional outcome.

Design: Seven hundred seventy six unselected, acute stroke patients who were admitted within seven days of stroke onset with unimpaired consciousness were included. If possible, the patients were assessed for manual and oral apraxia on acute admission. Neurologic stroke severity including aphasia was assessed with the Scandinavian Stroke Scale, and activities of daily living function was assessed with the Barthel Index. All patients completed their rehabilitation in the same large stroke unit.

Results: Six hundred eighteen patients could cooperate with the apraxia assessments. Manual apraxia was found in 7% of subjects (10% in left and 4% in right hemispheric stroke; $\chi^2 = 9.0$; $P = 0.003$). Oral apraxia was found in 6% (9% in left and 4% in right hemispheric stroke; $\chi^2 = 5.4$; $P = 0.02$). Both manual and oral apraxia were related to increasing stroke severity, and manual, but not oral, apraxia was associated with increasing age. There was no gender difference in frequency of apraxia. Patients with either type of apraxia had temporal lobe involvement more often than patients without. When analyzed with multiple linear and logistic regression analyses, neither manual nor oral apraxia had any independent influence on functional outcome.

Conclusion: Apraxia is significantly less frequent in unselected patients with acute stroke than has previously been assumed and has no independent negative influence on functional outcome.

Key Words: Manual Apraxia, Oral Apraxia, Stroke, Rehabilitation Outcome, Activities of Daily Living

Apraxia is "a neurological disorder of learned purposive movement skill that is not explained by deficits of elemental motor or sensory systems."[1] Apraxia can be present for different parts of the body, but manual and oral apraxia are most often assessed. In classic terminology, two forms of manual apraxia are differentiated: ideomotor apraxia, which is an impaired ability to demonstrate actions with imaginary objects, and ideatory apraxia, which is an impairment of actions with real objects. Recently, this distinction has been questioned as it has been shown that even patients with ideomotor apraxia use real objects in an abnormal way.[2] This finding has led some researchers to question the traditional view that ideomotor apraxia should be without functional consequences for patients.[3] Moreover, in patients with aphasia, apraxia might reduce the ability to compensate through gestures because an association between apraxia and spontaneous use of communicative gestures has been found.[4]

Apraxia has been a well-known cognitive symptom in brain injury for more than a century. It has been associated with aphasia and left hemispheric lesions but has also been found with right hemispheric lesions. Despite this long clinical tradition, we have insufficient knowledge about the basic facts of apraxia in stroke. This is true regarding the frequency of apraxia in acute stroke and, even more so, when it comes to the consequences for functional outcome. The present study investigated the frequency and functional consequences of manual and oral apraxia in a large, prospective study of unselected patients with acute stroke.

METHODS

This study is part of the Copenhagen Stroke Study described in detail elsewhere.[5] This setting is community-based and includes all admitted stroke patients from a well-defined catchment area, regardless of the age of the patient, severity of stroke, and condition of the patient before the stroke. In the area of Copenhagen studied, 88% of all stroke patients are admitted[6] and all stages of acute care, workup, and rehabilitation take place in the same, large stroke unit.

A total of 1014 patients with acute stroke were admitted during the study period (mean (SD) age, 74.5 (10.9) yr; 451 (44.5%) males and 563 (55.5%) females). Excluded were 396 patients who (1) were not admitted to hospital within the first week after stroke onset ($n = 76$), (2) had impaired consciousness on admission (Scandinavian Stroke Scale (SSS) consciousness score of 0 or 2, see below, $n = 162$), or (3) could not be assessed on acute admission because of urgent treatment needs or patient refusal to cooperate ($n = 158$). The 618 patients included were younger (73.3 (11.3) yr) than excluded patients (76.3 (10.0) yr; $t = 4.4$; $P < 0.001$), had lower mortality (9% compared with 39%; $\chi^2 = 134.4$; $P < 0.001$), and were more frequently male (49% male compared with 38% female; $\chi^2 = 12.4$; $P < 0.001$). The percentage of left hemispheric lesions was highest among the excluded patients (64% compared with 51.3%; $\chi^2 = 15$; $P < 0.001$).

Stroke was defined according to World Health Organization critera[7]: rapidly developed clinical signs of focal disturbance of cerebral function lasting more than 24 hr or leading to death with no apparent cause other than vascular origin. Subarachnoidal bleeding was not included.

A history of former stroke was obtained on admission. The hospital register containing information on diagnoses from former admissions was also studied. Information concerning comorbidity was obtained on admission and included other disabling diseases apart from previous strokes (e.g., amputation, multiple sclerosis, severe dementia, heart failure, latent or persistent respiratory insufficiency, parkinsonism). All information on admission was gathered by the physician who also performed the ratings and tests done on admission.

Stroke severity was assessed with the SSS.[8,9] The SSS evaluates level of consciousness; eye movement; power in arm, hand, and leg; orientation; aphasia; facial paresis; and gait. The total score ranges from 0 to 58 (normal) points. In a factor analytic study, we have previously shown that the neuropsychologic items (aphasia and orientation) of the SSS load on a factor separate from the single factor on which the other items of the SSS load.[10] We, therefore, also computed a separate "nonneuropsychologic" SSS total score excluding these items. This score ranged from 0 to 42 points.

Activities of daily living function was assessed by the Barthel Index (BI).[11] The BI was carried out during the first week of admission, every week during hospital stay, and at discharge. It evaluates ten different basic abilities and ranges in total score from 0 to 100 points.

Aphasia was assessed with the aphasia scale of the SSS. This scale divides aphasia into severe (the patient can say only yes/no or less), moderate (the patient can say more than yes/no but not longer sentences), mild (the patient has limited vocabulary or incoherent speech), and no aphasia. The levels of aphasia were assigned values from 0 (severe) to 3 (no aphasia).

Apraxia was assessed as manual and oral apraxia. To determine manual apraxia the patients were instructed to demonstrate how to point, wave, and salute. To determine oral apraxia, the patients were asked to protrude the tongue, fill the cheeks with air, and blow. For each correctly performed task, a score of 1 point was assigned. Thus, a score ranging from 0 to 3 could be obtained

TABLE 1
Basic patient characteristics according to presence or absence of manual and oral apraxia

	All Patients	Manual Apraxia			Oral Apraxia		
		Present	Absent	Statistics	Present	Absent	Statistics
Age, yr (SD)	73.3 (11.3)	78.2 (11.5)	72.9 (11.2)	$t = -2.9, P < 0.001$	74.1 (8.4)	73.2 (11.4)	$t = -0.45$, NS
Gender, male, %	48.9	37.5	49.7	$\chi^2 = 2.2$, NS	40.0	49.4	$\chi^2 = 1.2$, NS
Right handedness, %	93.8	94.1	93.8	$\chi^2 < 0.01$, NS	96.8	93.6	$\chi^2 = 0.5$, NS
Left side of stroke lesion, %	51.3	74.4	49.5	$\chi^2 = 9.0, P < 0.01$	70.6	50.0	$\chi^2 = 5.4, P < 0.02$
Mortality, %	8.9	27.5	7.6	$\chi^2 = 18.3, P < 0.001$	25.7	7.9	$\chi^2 = 12.9, P < 0.001$
Prior stroke, %	19.2	26.3	18.8	$\chi^2 = 1.3$, NS	20.6	19.2	$\chi^2 = 0.04$, NS
Comorbidity, %	18.5	8.5	18.8	$\chi^2 = 1.3$, NS	20.6	19.2	$\chi^2 = 0.6$, NS
Barthel index first week (SD)	64.8 (36.8)	31.6 (36.1)	67.1 (35.7)	$t = 5.8, P < 0.001$	42.6 (41.9)	66.2 (36.0)	$t = 3.2, P = 0.003$
SSS on admission (SD)	44.6 (11.0)	33.5 (12.8)	45.4 (10.4)	$t = 5.8, P < 0.001$	33.3 (16.0)	45.3 (10.2)	$t = 4.4, P < 0.001$
Neurologic score[a] (SD)	30.7 (9.6)	24.2 (11.6)	31.2 (9.3)	$t = 3.7, P = 0.001$	24.7 (13.7)	31.1 (9.2)	$t = 2.7, P = 0.01$

SSS, Scandinavian Stroke Scale; NS, not significant.
[a]SSS excluding the cognitive scores for speech and orientation.

for manual apraxia as well as for oral apraxia, with a score of 3 signifying no manual or oral apraxia and a score of 0 signifying severe manual or oral apraxia. The presence of both manual and oral apraxia was defined as a score below 3 on the tests. The assessors were careful to obtain cooperation in aphasic patients and employed a model for imitation if necessary. If cooperation was impossible to obtain, the patient was excluded. In case of severe hemiplegia of the dominant limb, assessment was done with the nonaffected limb. The assessment was not repeated later during the stay at the stroke unit.

Type, size, and localization of stroke lesion were determined by visual inspection of computed tomography (CT) scans. The size of the lesion was measured as the largest diameter. All CT scans were evaluated by the same radiologist who was blinded to patient data. The CT scans were obtained by a Siemens Somatom DR scanner (Siemens a/s, Borupvang 3, Ballerup, Denmark) and performed a median of 11 days after stroke onset (mean (SD), 19.1 (26.0) days).

Rehabilitation based on the Bobath technique was carried out daily for all patients by the nursing staff, physiotherapists, and occupational therapists in the stroke unit. Rehabilitation was completed in the stroke unit. Patients were discharged when further improvement in function was considered unlikely.

Statistics. Comparisons for continuous data were carried out with Student's nonpaired and paired t tests for single comparisons. Categorical tables were analyzed with the χ^2 test. Univariate correlations were performed with the Pearson correlation coefficient. The relative importance of multiple variables was evaluated with multiple linear regression (backward) and multiple logistic linear regression (Walden, backward). The required two-tailed significance level for all statistical tests was set at 0.05. All analyses were performed with the SPSS for Windows 10.0 statistical package.[12]

Ethics. The study was approved by the Ethics Committee of Copenhagen, approval number V.100.2263/91.

RESULTS

Patient Characteristics and Frequency of Apraxia

Table 1 shows the basic patient characteristics. Manual apraxia was found in 7% (10% in left and 4% in right hemispheric stroke; $\chi^2 = 9.0$; $P = 0.003$). Oral apraxia was found in 6% (9% in left and 4% in right hemispheric stroke; $\chi^2 = 5.4$; $P = 0.02$). Both manual and oral apraxia were significantly associated with increasing stroke severity (SSS and SSS excluding aphasia and disorientation scores), left-sided stroke lesion, higher mortality but not with handedness, prior stroke, or comorbidity. Manual apraxia was also associated with older age, which was not the case for oral apraxia. Two multiple linear regression analyses were carried out with the apraxia scores as dependent variables. Stroke severity, gender, age, comorbidity, prior stroke, handedness, and side of lesions were included as the independent variables. The resulting models included age for manual apraxia (along with stroke severity and side of stroke lesion), whereas age was not included in the model for oral apraxia (which included stroke severity and side of lesion).

Manual apraxia on acute admission was found in 40 (6.5%) of the stroke patients (Table 2). Oral apraxia was found in 35 (5.7%) (Table 3), and apraxia irrespective of type was found in 56 patients (9.1%) (Table 4). Nineteen patients (3.1%) had both oral and manual apraxia. Sixteen patients

TABLE 2
Frequency and severity of manual apraxia

Score	Frequency	Percent	Cumulative Percent
0 (Severe)	6	1	1
1	8	1.3	2.3
2	26	4.2	6.5
3 (No manual apraxia)	578	93.5	100
Total	618	100	

(2.6%) had oral apraxia but not manual apraxia. Twenty-one (3.4%) had manual but not oral apraxia. The manual and oral apraxia total scores were significantly correlated, $r = 0.62$ ($P < 0.01$). With a corresponding coefficient of determination of 0.38, this leaves 62% of the variance in one apraxia score unexplained by the variance in the other apraxia score. The frequency of apraxia was 14.0% in left hemispheric stroke and 6.1% in right hemispheric stroke. Manual apraxia was 10.4% in left and 4.2% in right hemispheric stroke. The frequency of oral apraxia was 9.0% in left and 4.2% in right hemispheric stroke. There were no left-handed patients among the patients with a right-sided stroke lesion and either manual or oral apraxia.

Association with Aphasia and Other Neuropsychologic Symptoms

Correlation of the apraxia scores with the aphasia score was lower than correlation among the two apraxia scores. Correlation of the manual apraxia score with the aphasia score was 0.28 ($P < 0.01$), and correlation of the oral apraxia score with the aphasia score was 0.36 ($P < 0.01$). Of the 40 patients with some degree of manual apraxia, 26 (65.0%) also had some degree of aphasia ($\chi^2 = 38.6$; $P < 0.001$) and 25 (71.4%) of the 35 patients with oral apraxia also had some degree of aphasia ($\chi^2 = 44.9$; $P < 0.001$). As can be seen from Table 5, the association of apraxia and aphasia is not much stronger than the associations of apraxia and orientation, body hemineglect, and anosognosia for hemiplegia.

Gender and Side of Stroke Lesion

There was a tendency for manual apraxia to be associated more often with right-sided stroke lesions in women (33.3%) than in men (13.3%), although this tendency was not significant ($\chi^2 = 1.94$; $P = 0.16$). This tendency was weaker for oral apraxia (33.3% in women, 23.1% in men; $\chi^2 = 0.41$; $P = 0.5$).

Psychometric Characteristics of the Apraxia Tests

Table 6 shows the psychometric difficulty of all apraxia items expressed as percentage of patients unable to perform the specific item. Protruding the tongue is the easiest item, and showing how to salute is the most difficult item. There is a fairly satisfactory distribution of levels of difficulty across the items. The reliabilities of the two apraxia scores were assessed by the internal consistency of the items expressed in Cronbach's α. It was found to be high for both manual apraxia score (0.69) and oral apraxia score (0.76), as well as for total apraxia score (0.82).

Computed Tomography Scan Findings

The CT scan characteristics are shown in Table 7. Hemorrhage was more common among patients with

TABLE 3
Frequency and severity of oral apraxia

Score	Frequency	Percent	Cumulative Percent
0 (Severe)	6	1	1
1	14	2.3	3.2
2	15	2.4	5.7
3 (No oral apraxia)	583	94.3	100
Total	618	100	

TABLE 4
Total apraxia scores

Score	Frequency	Percent	Cumulative Percent
0 (Severe)	3	0.5	0.5
1	2	0.3	0.8
2	6	1	1.8
3	8	1.3	3.1
4	8	1.3	4.4
5	29	4.7	9.1
6 (No apraxia)	562	90.9	100
Total	618	100	

TABLE 5

Associations of apraxia with aphasia and other neuropsychologic symptoms (correlations)[a]

	Manual Apraxia	Oral Apraxia
Oral apraxia	0.62	
Aphasia (SSS speech score)	0.28	0.36
Orientation (SSS orientation)	0.28	0.31
Visual hemineglect	0.21	0.16
Body hemineglect	0.33	0.32
Anosognosia for hemianopia	0.17	0.15
Anosognosia for hemiplegia	0.35	0.32

SSS, Scandinavian Stroke Score.
[a]All correlations are significant at the 0.001 level.

TABLE 6

Difficulty of apraxia test items expressed as percentage of patients unable to perform the task for each item

	Failed, *n*	Percent Failed, (Difficulty)
Show how to point	14	2.3
Show how to wave goodbye	12	1.9
Show how to salute	34	5.5
Show how to protrude the tongue	11	1.8
Show how to fill the cheeks with air	25	4
Show how to blow	25	4

oral apraxia than among patients without oral apraxia. A similar tendency in manual apraxia was present but nonsignificant. Both types of apraxia were associated with larger stroke lesions. Neither men nor women had any significant differences in their scores for manual apraxia according to the anterior/posterior localization of the stroke lesions on CT scans. Patients with lesions shown on CT scan were examined to determine whether manual or oral apraxia was associated with a specific region of the brain (cortical lobes and each of the subcortical structures: thalamus, basal ganglia, and internal capsule). The only significant association found was a more frequent involvement of the temporal lobes when either oral or manual apraxia was present. Of the patients with temporal lobe involvement, 14.5% had manual apraxia, whereas only 4.8% of the patients without temporal lobe involvement had manual apraxia ($\chi^2 = 7.9$; $P = 0.005$). The figures were similar for oral apraxia.

Functional Outcome

The possible influence of manual and oral apraxia on functional outcome was analyzed in survivors. Univariately, manual but not oral apraxia was associated with a poorer outcome. Manual apraxia had a weak but significant correlation with BI score at discharge ($r = 0.16$; $P < 0.01$), whereas oral apraxia had not ($r = 0.08$). Patients with manual apraxia were less often discharged to independent living (69%) than patients without (91%; $\chi^2 = 14.7$; $P < 0.001$). There was no significant difference in the rate of discharge to independent living in patients with and without oral apraxia (85% *vs.* 90%; $\chi^2 = 0.8$; not significant). A weak association with length of stay (corrected for time waiting for nursing home) was found for both manual apraxia ($r = 0.23$; $P = 0.049$) and oral apraxia ($r = 0.027$; $P = -0.45$). The univariate association between manual apraxia and poor outcome and length of stay was not found in the multivariate

TABLE 7

CT scan characteristics according to presence or absence of manual and oral apraxia

	Manual Apraxia Present	No Manual Apraxia	Statistics	Oral Apraxia Present	No Oral Apraxia	Statistics
CT performed, %	77.5	91.7	$\chi^2 = 9.0$, $P < 0.01$	88.6	90.9	$\chi^2 = 0.2$, NS
No focal lesion on CT, %	25.8	37.5	$\chi^2 = 1.7$, NS	25.8	37.5	$\chi^2 = 1.7$, NS
Infarct on CT, %	64.5	57.4	$\chi^2 = 0.6$, NS	58.1	57.5	$\chi^2 = 0.001$, NS
Hemorrhage on CT, %	9.7	5.1	$\chi^2 = 1.2$, NS	16.1	4.7	$\chi^2 = 7.5$, $P < 0.05$
Lesion size on CT, mm (SD)[a]	48.6 (28.7)	33.7 (22.4)	$t = -3.0$, $P = 0.003$	49.4 (31.2)	33.6 (22.1)	$t = -2.3$, $P = 0.03$

CT, computed tomography.
[a]For patients with visible lesions on their CT scans.

analyses. Multiple linear regression analyses were performed with the Barthel Index score at discharge as the dependent variable. Manual apraxia and oral apraxia were analyzed independently together with initial BI, initial stroke severity (SSS excluding aphasia and orientation), prior stroke, comorbidity, gender, age, and handedness as the independent variables. Neither manual nor oral apraxia had a significant independent influence on BI activities of daily living outcome. Similar analyses were performed with length of stay (corrected for the time spent waiting for nursing home) as the dependent variable. Manual and oral apraxia had no independent influence on length of stay in these analyses. Multiple logistic regression analyses were performed, with discharge to independent living as the dependent variable and with marital status added to the independent variables also used in the analyses of BI at discharge and length of stay. Neither manual nor oral apraxia was related to independent living after discharge.

DISCUSSION

Apraxia was present in 9% of unselected, acute stroke patients. Manual apraxia was found in 7% and oral apraxia in 6% of patients. Our test of manual apraxia corresponds to what has been named ideomotor apraxia. The only previous study to assess ideomotor apraxia in stroke, without including other etiologies, found ideomotor apraxia in 83 (54.6%) of 152 patients with a left hemispheric stroke examined within the first month of stroke.[13] This is a much larger figure than the 10% with manual apraxia and a left hemispheric stroke reported in this study. The reason for the much lower frequency in our study is probably that our sample was unselected and community-based, whereas the Kertesz et al.[13] sample was highly selected. Some underestimation of the incidence in our study could, however, have resulted from other factors such as the sensitivity of the apraxia assessments and exclusion of patients with impaired consciousness.

The tests we used were probably less sensitive than the tests used by Kertesz et al.[13] as they comprised fewer items. A relatively short test was necessary because of the number of patients included and because we wanted to test the patients at the time of acute admission when it was performed along with a large number of other assessments. The reliability and validity of the apraxia tests have not been established by prior studies. However, we found satisfactory figures for reliability in our study and the items used were selected from well-known apraxia examinations. The high internal consistency and spread in level of difficulty we were able show also support the validity of our assessment method. However, the sensitivity might be somewhat lower than in other studies. Two of the items in our test of oral apraxia were found by De Renzi et al.[14] to be the easiest items to perform in their eight-item test for oral apraxia, and our third item had the same difficulty as the most difficult of these two items. This corroborates our impression that our test was relatively easy.

A relatively large proportion of patients had to be excluded. The reason for this was the acute timing of the assessment during which a large number of patients had impaired consciousness and could not be tested. Most of the patients who could not be tested had severe stroke and a high mortality. However, as both types of apraxia are associated with stroke severity, a higher frequency of apraxia, as well as more severe apraxia, would be expected in the excluded patients.

Manual and oral apraxia were found to be significantly correlated. However, a clear dissociation was also found, which means that a patient can have one kind of apraxia without having the other kind. This is not a question of one kind of apraxia being simply a more severe form of apraxia than the other; it was possible to have oral apraxia without manual apraxia, as well as manual apraxia without oral apraxia. The dissociation of manual and oral apraxia corresponds to previous findings, e.g., the De Renzi et al.[14] findings in a group of patients with mixed etiology.

Apraxia was found to be associated with aphasia, but it could also be dissociated as has been found in previous studies, e.g., Kertesz[13] and Papagno[15] and their coworkers. The present study did, however, also investigate the association with other neurologic symptoms and found that associations with body hemineglect and anosognosia for hemiplegia were of almost the same magnitude as the association with aphasia.

The items chosen to assess apraxia were shown to have a psychometrically satisfactory distribution in difficulty and were internally consistent, which has positive implications for both the reliability and validity of the assessment.

Kimura[16] reported that apraxia was more often caused by anterior than by posterior lesions in women, whereas this was not the case for men. We could not confirm this finding. It should be noted that Kimura[16] reported a similar finding for aphasia that we could not confirm in our community-based population in a previous study.[17] The findings by Kimura[16] might be explained by sample selection. We found a tendency for manual apraxia to be more often associated with right hemisphere lesions in women compared with men. Although not statistically significant in this study, it is of interest to note as we have previously reported a similar finding for aphasia.[17] The possible implication is that more women than men may have an inverse hemispheric specialization.

The association with temporal lobe lesions was somewhat unexpected. One possible explanation is that stroke lesions affecting the temporal lobe often go deep and may include the deep parieto- and occipitofrontal fibers that Kertesz and Ferro[18] found to be important together with anterior callosal fibers in ideomotor apraxia. The validity of these findings is limited by the inaccuracy of CT scans in localizing brain lesions,[19] and some scans were done early after stroke when it cannot be assumed that the full lesion is visible on the CT scan.

Oral apraxia was not associated with functional outcome, either univariately or multivariately. Manual apraxia had a univariate association with outcome activities of daily living and discharge to independent living that, however, disappeared when other possible predictors were taken into account. Only a few previous studies have been concerned with this question, and most have not taken the multivariate nature of the question into account. Two multivariate studies of smaller and selected populations have had dissimilar results.[20,21] The number of patients with moderate or severe apraxia was not large, which limits the statistical power. However, there was not even a tendency toward statistical significance, and the number of apractic patients was not small compared with the above-mentioned two previous studies. In the Copenhagen Stroke Study, it was found that aphasia,[22] hemineglect,[23] and now apraxia did not independently influence functional outcome, whereas such an influence was found for anosognosia,[24] orientation,[25] and general intellectual function.[26] It has been suggested[27] that this might be explained by the theory of Fodor[28] that describes modular (or vertical) *vs.* general (or horizontal) functions. Modular functions are limited to a single cognitive domain, are relatively encapsulated and context independent, may be more or less neuronal "hard-wired," are cognitively impenetrable, and may be involuntarily initiated. General functions span across cognitive domains and may be important for conscious cognitive strategies. It seems that more modular functions may mean less for functional outcome than more general functions. The reason could be that general functions are important for the ability of the patient to gain from rehabilitation and to perform compensation, whereas modular functions can themselves be compensated by different means.

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Book Review

Post-Polio Syndrome: A Guide for Polio Survivors & Their Families, by Julie K. Silver, MD, Published 2001. Yale University Press, New Haven. $27.50

This is a 250-page book with lots of "down-to-earth" information. The author is an assistant professor of physical medicine & rehabilitation at Harvard University and became interested in polio as a child when she was confronted with a grandfather who had complications from bulbar polio that worsened as he aged. The volume is organized into 26 chapters, covering finding expert medical care, pain, falls, fatigue, community resources, among many others. In fact, this could be a primer on rehabilitation of any number of disabling conditions. To cavil a bit, there are some errors that could be significant to a health professional but would be overlooked by a lay person. For example, when discussing ideal weight, Dr. Silver might have used the 42% muscle of a female and then estimated the loss of muscle tissue because of the polio and generate a more accurate figure of ideal weight. This will be shocking to any postpolio person who comes in with a preconceived notion of what it should be. I was somewhat concerned when the chapter on exercise did not distinguish between joint contracture and "tight" two-joint muscles. These are the major problems in postpolio. Discussing "falls" without at least mentioning an occasional need to teach "HOW TO FALL" was not "physiatric." Sooner or later, the clinician will be faced with this dilemma. In this chapter on travel, there was only a passing mention of the need for vans and the superb conversions that are now available. Of course, the word "extremity" instead of limb was rife. Nevertheless, this is an excellent production for postpolio persons and their families and could even be very helpful to physicians who are not up-to-date on postpolio syndrome.

Book Rating: ****

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