Brief Report

Gait Speed and Survival in Patients With Brain Metastases

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Abstract

Context. Accurate estimation of life expectancy in patients with brain metastases is critical for counseling and choosing appropriate therapy. Performance status is the single greatest determinant of overall survival in this population. However, current measures of performance status are subjective and often based on brief clinical encounters. Gait speed is an objective, reliable predictor of overall health and survival.

Objective. The purpose of this study was to evaluate the relationship between gait speed and survival in patients with brain metastases.

Methods. We conducted a retrospective review of all patients with documented gait speed and Karnofsky performance status seen in consultation for newly diagnosed brain metastases from 2014 to 2015. Gait speed was measured during neurological examination over 4 m at normal pace. Graded prognostic assessment scores were calculated from clinical information. The primary outcomes were overall survival and 30-day mortality.

Results. Eighty-five of 88 patients (97%) met inclusion criteria. Overall, the median gait speed was 0.7 m/s (range 0–1.0 m/s). Gait speed was associated with increased overall survival in addition to graded prognostic assessment score. Median survival was longer in patients with normal gait speed (>0.6 m/s, 11.9 months) compared to those with slow gait speed (≤0.6 m/s, 4.5 months, $P < 0.001$) or who were nonambulatory (1.1 months, $P < 0.001$). Thirty-day mortality for normal, slow, and nonambulatory patients was 0%, 15%, and 42%, respectively. The graded prognostic assessment overestimated actual survival for nonambulatory patients (2.2 vs. 1.1 months) and underestimated for those with normal gait speed (4.4 vs. 11.9 months).

Conclusion. Gait speed is associated with overall survival in patients with newly diagnosed brain metastases. Gait speed assessment is simple, objective, and may provide additional prognostic information to improve life expectancy estimation and management decisions.   J Pain Symptom Manage 2017;■:■–■. © 2017 American Academy of Hospice and Palliative Medicine. Published by Elsevier Inc. All rights reserved.

Key Words
Gait, walking, brain neoplasms, survival

Introduction

Brain metastases are the most common intracranial tumors in adults and affect as many as 20% of all cancer patients.[1] With radiotherapy and systemic therapy advances, survival after a diagnosis of brain metastases can vary broadly from just a few months to nearly two years.[2] Brain metastasis in the setting of metastatic cancer is a heterogeneous disease that impacts many critical organ systems with global effects on overall health and mortality that are difficult to quantify. As a result, numerous prognostic indices for estimating survival of patients with brain metastases have been published to aid with patient counseling and management.[2–4] Many patient and disease characteristics have been found to be predictive of survival, but performance status, or the measure of general well-being, has been the dominant prognostic factor in patients with brain metastases. The two most commonly used measures of performance status rely on subjective assessment, often based on a brief clinical encounter of the patient's

ability to perform basic tasks of daily living.[5,6] Given the importance of performance status in prognosis and management of patients with brain metastases, a simple, objective, and reproducible measure would be useful in clinical practice and clinical trials.

In older adults, gait speed is a reliable indicator of overall health and functional status. Furthermore, gait speed adds substantially to the predictive values of age and gender and is similar in predictive value to more complex measures of health.[7] Because gait speed is objective and easily measured, even in extremely complicated clinical scenarios, we hypothesized that gait speed measurement would add clinically useful prognostic information for patients with brain metastases.

Methods

Study Population

The records of all patients seen in consultation for a new diagnosis of brain metastases in an academic, hospital-based radiation oncology department from August 2014, coinciding with incorporation of gait speed assessment into our standard neurological examination of all patients with brain metastases, to October 2015 were reviewed with institutional review board approval. All patients for whom gait speed was assessed at the time of initial consultation and with clinical information available for calculation of the Graded Prognostic Assessment (GPA) score were included.[4] The GPA is a validated prognostic index widely used to estimate survival of patients with brain metastases based on clinical characteristics. Clinical information abstracted from patients' charts for GPA calculation included age, Karnofsky performance status (KPS), number of brain metastases, and presence of extracranial metastases.

Gait Speed Measurement

To assess gait speed during the routine neurological examination, patients were asked to walk 4 m at their usual pace after starting from a standing position.[7] The time to complete the walk was measured by a clinician using a stopwatch. Gait speed, therefore, was defined as the average speed over the 4 m distance and was recorded in 0.1 m/s increments. The use of mobility aids during ambulation, when documented, was allowed. Patients who could not walk or did not feel comfortable walking safely were recorded as having a gait speed of 0 m/s and considered nonambulatory. Performance status was documented by providers at the time of consultation using the KPS scale and generally after performing gait speed measurement.

Gait speed measurements were used to separate patients into three categories: nonambulatory, slow ($\leq$0.6 m/s), or normal ($>$0.6 m/s).[7–9] Differences in frequencies between groups were assessed using the Pearson χ^2 test. Differences in means were assessed using the independent samples t-test or independent samples Kruskal-Wallis test, where appropriate.

The primary outcome was death from any cause. Overall survival was defined as the time from diagnosis of brain metastases to death. Survival estimates were generated using the Kaplan-Meier method and were compared using the log-rank test. Gait speed category and GPA score were included in a multivariate Cox proportional hazards model to assess for independent effects on the hazard for death. Because KPS is included in the GPA score, we did not perform a separate analysis with KPS as a covariate.

Results

Population Characteristics

Eighty-eight patients were seen in consultation with newly diagnosed brain metastases during the reference period. Eighty-five patients (97%) met the inclusion criteria for this study with final data collection performed in August 2016. At the time of analysis, 57 (68%) had died, and the median follow-up of surviving patients was 10.3 months (range 0.9–21.3 months). Across all patients, the median gait speed was 0.7 m/s (range 0–1.0 m/s). Demographics and disease characteristics are presented in Table 1.

Table 1
Patient and Disease Characteristics Categorized by Gait Speed

Clinical Characteristics	Overall (n = 85)	Nonambulatory (n = 19, 22.4%)	Slow (GS ≤ 0.6 m/s, n = 20, 23.5%)	Normal (GS > 0.6 m/s, n = 46, 54.1%)	P-Value
Gait Speed, mean (SD), m/s	0.55 (0.37)	0 (0)	0.38 (0.16)	0.85 (0.12)	<0.001
Age, mean (SD), yrs	61.5 (10.3)	60.6 (13.6)	66.8 (9.8)	59.6 (7.8)	0.035
Female, no. (%)	49 (57.6)	12 (63.2)	11 (55)	26 (56.5)	0.85
White, no. (%)	57 (67.1)	11 (57.9)	10 (50)	36 (78.3)	0.05
Limited brain metastases (1-3), no. (%)	44 (51.8)	3 (15.8)	12 (60)	29 (63)	0.001
Extracranial metastases, no. (%)	57 (67)	15 (78.9)	16 (80)	26 (56.5)	0.08
Initial KPS, median (range)	70 (20–100)	50 (20–80)	70 (50–80)	80 (60–100)	<0.001
GPA score, median (range)	1.5 (0–4)	1 (0–1.5)	1.25 (0.5–2.5)	1.75 (0.5–4)	<0.001
GPA-predicted survival, mean (SD)	3.8 (1.6)	2.9 (0.5)	3.2 (0.6)	4.4 (2.0)	<0.001

GS = gait speed; KPS = Karnofsky performance status; GPA = graded prognostic assessment.