Quality of life in patients with glioblastoma multiforme participating in a randomized study of brachytherapy as a boost treatment

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Object. Until recently the assessment of outcome in patients treated for glioma has emphasized length of survival with the evaluation of quality of life (QOL) limited to unidimensional, mostly physical, measures. The authors report the multidimensional assessment of QOL as part of a randomized clinical trial of brachytherapy as a boost in the initial treatment of patients with glioblastoma multiforme.

Methods. A questionnaire previously developed by the senior authors and psychometrically validated was completed by patients on randomized entry into the study and at follow-up review every 3 months thereafter. The questionnaire was presented in a linear-analog self-assessment format. Karnofsky Performance Scale (KPS) scores were also recorded on each occasion.

No differences were found between patients in either arm of the study (conventional radiation therapy consisting of 50 Gy in 25 fractions or conventional radiation plus a brachytherapy boost of a minimum peripheral tumor dose of 60 Gy) in KPS and QOL scores during the 1st year of follow-up review. However, there was a statistically significant deterioration in patients’ overall KPS scores during the 1st year of follow up compared with baseline scores. Of QOL items evaluated, statistically significant deteriorations were found in self care, speech, and concentration, and on subscale analyses, cognitive functioning and physical experience (symptoms) deteriorated significantly during the 1st year of follow up, compared with baseline values. The correlation between QOL and KPS scores was low.

Conclusions. Future studies in patients harboring malignant gliomas must incorporate measures assessing QOL because traditional measures focusing on physical or neurological functioning give an incomplete assessment of the patient’s experience.

Key Words • quality of life • glioblastoma multiforme • randomized trial • brachytherapy

The recently completed randomized study of brachytherapy in the initial treatment of patients with malignant glioma undertaken at the University of Toronto was designed to determine primarily whether the addition of brachytherapy would convey a survival benefit to patients receiving external-beam radiation therapy.

The difference in duration of survival in patients who received brachytherapy and those who did not was not statistically significant. Patients entered into this trial completed QOL questionnaires at 3-month intervals in addition to undergoing clinical neurological examinations and imaging evaluations.

The questionnaire was produced in a linear-analog self-assessment format (Table 1). The core instrument was developed at the Princess Margaret Hospital in Toronto by investigators who had also developed a breast cancer module. A brain tumor module was subsequently developed and, in addition to its use in the randomized brachytherapy study that forms the basis of this report, the combined instrument was recently provided to other investigators to assess QOL in patients who participated in a randomized study of pion radiation therapy for treatment of high-grade astrocytoma.

The advantages of a broader and, from the patient’s point of view, more relevant definition of outcome are now more evident. This definition includes measures of social and mental well-being, together with the traditional measures of physical well-being, length of survival, and incidence of major or minor morbidity.

The results of several recent trials on the treatment of glioma, which have shown only moderate or no benefit in length of survival of patients treated with invasive and/or potentially toxic regimens, provide an increasing rationale for this point.
TABLE 1

Quality of Life Measurement (1 Day): the Toronto Instrument

We have made a list which covers important features of life and we will ask you to score these at particular times by making a mark on the line. The first time you do this, someone will be present to explain the scoring. We wish you to score the effects of THE STATE OF YOUR HEALTH RELATING TO YOUR CURRENT ILLNESS (that is, your brain tumor and its treatment). Factors which influence your life but are not health related should not be considered. For example, if you are unable to drive your car because you are too ill or too worried about yourself, this would be a reduction in your mobility that is related to your health. However, if you never learned to drive or your car is broken down, you may be less mobile than your neighbor but this is not due to illness and you should score it as normal.

EXAMPLES

<table>
<thead>
<tr>
<th>Eating</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>not eating</td>
<td>normal eating</td>
</tr>
<tr>
<td>Mobility around home, town or country</td>
<td></td>
</tr>
<tr>
<td>completely restricted to bed</td>
<td>travelling around normally</td>
</tr>
</tbody>
</table>

INITIALS D.O.B. DATE MONTH

PLEASE SCORE HOW YOU FEEL EACH OF THESE ASPECTS OF YOUR LIFE WAS AFFECTED BY THE STATE OF YOUR HEALTH, DURING TODAY (24 HRS).

1. Energy
   - no energy at all
   - normal energy

2. Nausea
   - extremely severe nausea
   - no nausea

3. Vomiting
   - extremely severe vomiting
   - no vomiting

4. Mobility around home, town or country
   - completely restricted to bed
   - travelling around normally

5. Regular out-of-home employment
   - not working at all
   - normal work

6. Reading
   - I cannot read at all
   - normal reading

7. Hair loss
   - complete hair loss
   - no hair loss

8. Self care (washing, cosmetics, dressing, toilet)
   - completely unable to care for myself
   - caring for myself normally

9. Inconvenience of treatment
   - extremely disruptive to my life
   - no disruption to my life

10. Anger
    - extremely angry
    - not angry at all

11. Headache
    - extremely severe headache
    - no headache

12. Physical activity
    - completely unable to move my body
    - normal physical activity

13. Recreation, pastimes, or hobbies
    - completely unable to do them
    - normal leisure time activities

14. Level of anxiety
    - extremely anxious
    - not anxious at all

15. Fatigue
    - extremely tired
    - not tired at all

16. Social life, meeting and dealing with people outside the family
    - extremely unsatisfactory
    - normal social life

17. Sleep
    - (COMPLETE a OR b)
      - (a) completely unable to sleep
      - normal sleep
    - (b) much more sleep than usual
    - OR normal sleep

18. Depression
    - extremely depressed
    - not depressed at all

19. Appearance of your body
    - extremely dissatisfied
    - completely satisfactory at my age

20. Family relationships and marriage/cohabitation
    - (COMPLETE a OR b)
      - (a) extremely bad relationships
      - normal family life
    - OR
      - (b) extremely good relationships
      - normal family life

21. Household duties
    - no household duties
    - normal household duties

22. Eating
    - (COMPLETE a OR b)
      - (a) not eating
      - normal eating
    - OR
      - (b) greatly increased eating
      - normal eating

23. Speech
    - completely unable to speak
    - normal speech

24. Writing
    - completely unable to write
    - normal writing
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TABLE 1 (continued)

| 25. Information about disease and treatment | completely satisfied w/ the way my medical situation has been explained |
| 26. Concentration | able to concentrate normally |
| 27. Pain of treatment | no pain from treatment |
| 28. Memory | my memory is normal |

OVERALL SCORE

29. PLEASE SCORE HOW YOU FEEL YOUR LIFE HAS BEEN AFFECTED BY THE STATE OF YOUR HEALTH (any disease or treatment) DURING TODAY (24 HOURS). You may like to look back over the previous scales and consider the scores you have made and how much you feel they have affected your life. (COMPLETE a OR b)

(a) my life is much worse my life is normal w/ no changes
(b) my life is much better my life is normal w/ no changes

The repeated demonstration that brain tumors and their treatment cause specific neurological toxicity and the realization that, in addition to survival, patients are concerned about the disabilities and handicaps that result from impairments at the organ level have appropriately promoted needs-based appraisals of these multidimensional problems. This has required the development and psychometric validation of instruments designed to obtain a more complete health assessment of patients with brain tumors. The strategy adopted by several investigators has been the use of the modular approach: a combination of generic (core) instruments and specific instruments. Studies in which such combined instruments are used are designed for greater sensitivity in evaluating the effects of impairment of the organ of special interest (Table 2).

Clinical Material and Methods

Patient Population

The trial was designed to compare conventional external radiation therapy alone (50 Gy in 25 fractions) with conventional radiation therapy plus a brachytherapy boost (minimum peripheral tumor dose of 60 Gy to all enhancing disease) in patients with newly diagnosed malignant astrocytomas. Between 1986 and 1996, 140 patients were randomized into the study. Inclusion criteria were as follows: 1) biopsy-proven supratentorial malignant astrocytoma; 2) age 18 to 70 years; 3) KPS score higher than 70; 4) no involvement of the corpus callosum or brainstem; and 5) maximum tumor diameter of less than 6 cm.

Quality of Life Questionnaire

The core instrument of the multidimensional QOL questionnaire that was completed by patients recruited for this study was derived from the Sickness Impact Profile. It consists of 16 items dealing with general health problems that could be classified under the categories of physical, role, cognitive, social, and emotional functioning and functional well-being. The questionnaire has been psychometrically validated by investigators who also developed a disease-specific module for assessing patients with breast cancer. Items are presented in a linear-analog self-report format. Each item to be assessed is represented by a 10-cm line anchored at each end by descriptive phrases that define the extremes of responses that might be associated with that item. The position marked by a patient on the line between the extremes represents the quantitative score of his or her self-assessment for that scale.

The brain tumor module of the instrument (University of Toronto) was developed by the senior authors before the inception of the randomized study. This module consists of 13 items derived from our clinical experience with patients harboring brain tumors and an additional item assessing overall QOL. These are single independent items that could be classified under the physical-experience (that is, a symptom scale) and relationship-with-doctor domains of the FACT-BR and EORTC QLQ C30 with the BCM20. All items are randomly ordered in the questionnaire to reduce the chance of scores on one item influencing scores on related adjacent items (Table 1). The questionnaire takes approximately 10 minutes to complete.

An initial (baseline) QOL questionnaire was filled out by patients after randomization and admission into the study, and thereafter at intervals of 3 months. In addition, KPS scores and administered dosages of dexamethasone sodium phosphate (Decadron) were recorded.

Statistical Analysis

Changes in QOL and KPS scores were calculated as the differences between median values during the 1st year of follow-up review and baseline values. Data collected during the 1st year of follow-up review were used in the main analysis because the number of questionnaires returned subsequently was very small: 22 for Month 15 and 14 for Month 18 (Fig. 1). For physical and cognitive functioning and functional well-being, we believed that a test in which normality is assumed was inappropriate. However, because none of the score values was truly normal, we chose to apply nonparametric tests. The differences between the two arms of the study were tested using the Wilcoxon rank-sum test. The changes in QOL and KPS scores during follow up (longitudinally) were tested using the Wil-
The linear associations between changes in KPS scores and changes in QOL items and subscales were investigated by calculating the Spearman correlation coefficients. A repeated analysis was also performed; however, because of doubts concerning the scores’ distribution, the results should be interpreted with caution. Because the 1-year cut-off point was chosen arbitrarily, nonparametric tests were also applied to the whole dataset and the repeated analysis was performed for the first 15 months of follow-up review.

Based on Dubey’s16 recommendation we adjusted for multiplicity and chose α levels of 0.001 for item analyses and 0.005 for subscale analyses.

### Results

#### Pilot Project: Questionnaire Validation

In a previously reported pilot study of 40 patients harboring brain tumors,10 the questionnaire was found to have good reliability and validity.204230 It was used to distinguish reliably between patients with low KPS scores and those with higher scores (Table 3). Crohnbach’s α coefficient,36 a test of the internal consistency of the instrument, was found to be 0.8 and, in the assessment of test–retest reliability, the average Pearson’s product-moment correlation between the initial test and retest after 24 hours was 0.71. For overall QOL (Item 29), the correlation coefficient was 0.82. The minimum standard of internal consistency is an α coefficient of 0.7, and for test–retest reliability, a Pearson correlation coefficient greater than 0.7 is regarded as strongly supporting reliability.23364554

#### Randomized Study

The distribution of patient characteristics and treatment given at tumor recurrence in the two study arms of the randomized study has been previously reported.26 Of the 140 patients who were randomized to either arm of the study, 129 patients completed at least one QOL questionnaire. The number of patients who completed questionnaires...
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was approximately equal in both arms of the study at each point in time (Fig. 1) and, as expected for a study in which the median lengths of survival for those in the group that received the implant and those in the group that did not were found to be 13.8 and 13.2 months, respectively,26 the total number of patients who completed the questionnaires dropped rapidly to 31 patients at 12 months (Fig. 1). The long tail in the survival curve also mirrors the few long-term survivors in the group of patients who received the implant.26 Reasons for nonparticipation in the self-reported QOL assessment included the following: inability to read, misunderstanding of instructions for questionnaire completion, being overwhelmed by the disease, and refusal to participate. No correlations were found between patient QOL or KPS score and either sex or age.

Quality-of-Life Assessments and Comparisons

Comparisons of median KPS scores during the 1st year of follow-up with baseline scores showed a statistically significant difference, with a very small probability value ($p < 10^{-9}$). Of the 116 patients for whom the difference in KPS scores was calculated, 86 (74%) displayed a deterioration. However, the change in KPS scores over time was not statistically significant between the two treatment arms.

Comparisons of the change in QOL scores showed no statistically significant difference between the two arms of the study (Fig. 2). Of the 29 items, the following showed a statistically significant deterioration in the 1st year of follow-up review, compared with baseline values: vomiting, self care, speech, and concentration.

The linear relationships between the 29 item scores and KPS scores were investigated. The Spearman correlation coefficients were found to be low in all instances, ranging from 0.19 for eating to 0.3 for reading. The value for Item 29 (overall QOL) was less than 0.0001. To perform a more rigorous analysis, similar comparisons were performed on subscales, represented by similar items grouped together that assess a single domain (as determined by previous factor analysis and also similar groupings in FACT-Br and EORTC QLQ C30 with the BCM20; Table 4). Patients’ cognitive functioning and physical experience (symptoms) deteriorated significantly during the 1st year.

TABLE 3

<table>
<thead>
<tr>
<th>KPS Score</th>
<th>No. of Patients</th>
<th>Median LASA Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>90, 100</td>
<td>18</td>
<td>9.5</td>
</tr>
<tr>
<td>50, 60, 70, 80</td>
<td>22</td>
<td>7.5</td>
</tr>
</tbody>
</table>

*p < 0.0001 (Mann–Whitney test). Abbreviation: LASA = linear-analog self-assessment.
of follow up compared with baseline values (Fig. 3). No significant differences were found in comparisons between the two treatment arms and, as was the case in single-item analyses, the Spearman correlations between the subscale scores and KPS scores were low; ranging from -0.0056 for emotional functioning to 0.28 for cognitive functioning. Further analyses in which a repeated-measures analysis was used resulted in findings that were broadly concordant with those simpler analyses in which the Wilcoxon test was used (Table 5). In addition to significant deterioration of cognitive functioning and physical experience, physical functioning was also shown to deteriorate significantly with time. Extending the period of evaluation from 12 to 15 months did not significantly affect these findings.

We previously reported that, in patients who participated in the randomized trial, repeated surgery performed at the site of the original tumor was associated with improved survival time. Rates of repeated surgery were 33% in patients who did not receive brachytherapy and 31% in patients who did receive brachytherapy. Comparisons of the difference in QOL between patients who underwent repeated surgery and those who did not demonstrated no statistical significance. Moreover, patients in the brachytherapy group who underwent repeated surgery did not have a statistically significant difference in QOL compared with patients in the same group who did not undergo repeated surgery (0.96 > p > 0.21).

**Discussion**

To the best of our knowledge this is the first systematic appraisal of multidimensional QOL of patients in a prospective randomized trial of the therapy of malignant glioma.

Our findings of no significant differences between both treatment arms in the aspects of QOL assessed by our instrument are important and encouraging news to clinicians in search of more efficacious (and possibly more invasive) methods of treating this devastating disease. Our findings are consistent with those of Pickles, et al. In their comparison of higher-linear-energy transfer pion and photon radiation in the treatment of high-grade astrocytoma, global QOL (as assessed by the University of Toronto instrument) appeared to be maintained well longitudinally compared with pretreatment levels. However, no statistical analyses were performed between the two arms of that study and an evaluation of the different dimensions of QOL in the questionnaire was not undertaken. Also, contrary to our findings, KPS and QOL scores were found to be highly correlated in the pion radiation study. A reasonable interpretation of our findings would be that disease-related morbidity of malignant astrocytoma in our setting is still considerably more significant than treatment-related morbidity. This would be consistent with the findings of those of Taphoorn and colleagues, who concluded from their cohort study that the disturbances of cognition and emotion found in patients treated for low-grade glioma could not be attributed to radiation therapy because they occurred with equal incidence in both cohorts of patients treated with either early radiation therapy or observation after biopsy or surgical resection. In another recent study of the QOL of patients with low-grade glioma after radiation therapy—the randomized
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A phase III trial conducted by the EORTC (Trial 22844)—23 patients completed a validated multidimensional QOL instrument. The results showed a statistically significant increase in symptoms (fatigue/malaise and insomnia) in the higher radiation dose group (59.4 Gy in 6.5 weeks as opposed to 45 Gy in 5 weeks) immediately after radiotherapy.23 To some extent, this is consistent with our findings. Although no significant difference was detected between both treatment arms, there was a significant increase in symptoms (physical experience) with time (Table 5). In addition, 7 to 15 months after randomization, impaired leisure-time activity and emotional functioning was demonstrated in the higher radiation dose group in the EORTC study.23

In their reports on a survey of caregivers of patients with brain tumors, Meyers and colleagues33,34 showed that impairments of executive functions (memory, reasoning, problem-solving, and judgment) were the most frequently cited problems, compared with impairments in balance or walking. In other words, cognitive impairments that prevent return to work are more common than physical disability. This is consistent with our findings of a statistically significant deterioration in cognitive functioning over time, although no difference could be detected between both treatment arms (Table 5). The significant deterioration in physical functioning, although consistent with the significant deterioration of the KPS score over time, is only apparent after performance of modeled analyses that take into account correlations between answers of the same person (Table 5). The rationale for improving measures of patient outcome is thus to a large extent evident from our results. The instruments most commonly reported on in the neurosurgical literature focus predominantly on physical outcome (unidimensional) measures such as the KPS scale,22 the Medical Research Council Neurological Status Scale, or the World Health Organization Clinical Performance Status Scale.7,11 These are predominantly measures of physical impairments and disabilities, and reflect disturbances at the organ level and the level of the person, respectively.2,12,56 Although the KPS is useful and has good interrater reliability5,57 and construct and predictive validity,3,0,42,46,57 assessment of a patient using this scale would seem to fall short of the criteria required by the World Health Organization’s definition of health: “...a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity.”75 Patients’ handicaps—their disadvantages relative to others resulting from impairment and disability, in other words their social experience—should be measured as well.1,16,56 This is best done in the first instance by using multidimensional (profile) instruments.1,3,13,20,52

In answering questions of how and what to measure after a determination has been made to be more exact in defining QOL, the consensus of most researchers in the field is that QOL assessment is essentially subjective and that patients are the primary source of information on their particular QOL.1,3-5 However, especially in cases of brain tumor in which the validity of a patient’s judgment is sometimes in question, useful information can often be derived from family members and medical personnel.1,7,15 This can be achieved by using a combination of instruments, such as the physician-rated KPS and self (patient)-reported multidimensional (profile) instruments.1,3,5,7 The current status of methodology used in brain tumor QOL research is summarized in Table 2. Thirteen multidimensional instruments that have been used in brain tumor studies since 1985 were identified through a Medline search, including a report on the Glioma Outcomes project in Neurosurgical Focus, available on the internet.3 The optimum instrument combines a multidimensional scale with a brain-tumor module1-3,13,32 and has demonstrable reliability, validity, and sensitivity or responsiveness.1,3,12,20 The advantage of using a health profile instrument—the ability to detect differential effects on several aspects of health status (but with insufficient focus on the area of interest)—is combined with that of a disease-specific instrument to increase sensitivity or responsiveness.1,20 The FACT-BR, the EORTC QLQ C30 with the BCM 20, and the Toronto Instrument are three instruments fulfilling these criteria (Table 2). In a recent study, Weitzner, et al.,35 revalidated the FACT-G in patients with primary brain tumors and developed a brain subscale. They also found a low correlation between FACT-G total and subscale scores and KPS scores. This is consistent with our findings and again emphasizes the role of multidimensional QOL assessment in neurooncology. In the study by Osoba and associates,38 in which the EORTC QLQ C30 was used along with the BCM20 to assess a cohort of patients with malignant glioma, a wide range of health-related QOL scores for each KPS level was found. For example, patients with a KPS score of 100 had health-related QOL scores ranging from 60 to 100. This is a ceiling effect of the KPS,22 which has been noted by other investigators who use a concurrently administered multidimensional

<table>
<thead>
<tr>
<th>Subscales from the FACT-BR and the EORTC QLQ C30 with the BCM20 as applied to the Toronto Instrument</th>
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</thead>
<tbody>
<tr>
<td>physical functioning</td>
</tr>
<tr>
<td>role functioning</td>
</tr>
<tr>
<td>cognitive functioning</td>
</tr>
<tr>
<td>social functioning</td>
</tr>
<tr>
<td>emotional functioning</td>
</tr>
<tr>
<td>functional well-being</td>
</tr>
<tr>
<td>physical experience</td>
</tr>
<tr>
<td>relationship w/ doctor</td>
</tr>
<tr>
<td>global quality of life</td>
</tr>
</tbody>
</table>

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The responsiveness of the QOL instrument was thus superior to the KPS and demonstrated significantly worse physical, role, and cognitive functioning as well as global QOL in patients with recurrent high-grade glioma compared with the recently diagnosed cohort.

The problems of administration and interpretation of a multidimensional instrument in the context of a large clinical trial have been addressed and some measures suggested to help solve them. In addition to the approach posited by Choucair and coworkers\(^1\) that several smaller instruments be combined, including some rated by an observer, Sadura, et al.\(^4\) have suggested several strategies that might contribute to a questionnaire completion rate of 95% or higher. These include completion of questionnaires by patients while in the clinic (during time spent waiting to be examined) and a questionnaire that allows patients to respond in less than 10 minutes, a criterion that was met by the EORTC instrument.\(^4\) Our questionnaire completion rate of just above 66% (Fig. 1) compares favorably with the 40% reported by Choucair and coworkers,\(^1\) although their study was a multiinstitutional trial, and the 44% rate (at follow-up review) reported by Pickles, et al.\(^3\)

Other modes of administration of questionnaires, such as conducting a personal interview at the clinic or by telephone, maximize the response rate.\(^2\) However, these methods are more resource intensive than a self-report, require the training of interviewers, and may reduce the willingness of patients to acknowledge problems. It also limits the format of the instrument.\(^2\) Analysis and interpretation of data with multiple endpoints (as found in data obtained from a QOL questionnaire) is also an area that will require more work (Table 5). No unique or optimum method exists at present.\(^5\) A confounding factor that could have affected the interpretation of our data is the high rate of patient drop out (Fig. 1). Obviously as patients drop out due to increased morbidity or death, assuming that the other patients are stable, the mean observation could actually improve.

Once data has been collected and analyzed it could be used in several ways.\(^7,5\) In the context of a randomized controlled clinical trial, a responsive instrument could provide detailed information about selected aspects of QOL that could be used not only as part of the assessment of outcome (as in our situation), but also as useful insights into ways of improving interventions to lessen their impact on susceptible aspects of QOL.\(^3\) The use of methylphenidate is one such measure that can be taken, in addition to others, in cognitive and vocational rehabilitation programs, to address the problem of neurobehavioral slowing in patients with brain tumor.\(^4,5\)

### TABLE 5

<table>
<thead>
<tr>
<th>Domain</th>
<th>Wilcoxon’s Signed-Rank Test (p value)</th>
<th>Repeated-Measure Analysis (p value)</th>
</tr>
</thead>
<tbody>
<tr>
<td>physical functioning</td>
<td>0.0795</td>
<td>$&lt;0.0001^*$</td>
</tr>
<tr>
<td>role functioning</td>
<td>0.8629</td>
<td>0.2539</td>
</tr>
<tr>
<td>cognitive functioning</td>
<td>0.0002*</td>
<td>$&lt;0.0001^*$</td>
</tr>
<tr>
<td>social functioning</td>
<td>0.544</td>
<td>0.3216</td>
</tr>
<tr>
<td>emotional functioning</td>
<td>0.4748</td>
<td>0.3216</td>
</tr>
<tr>
<td>functional well-being</td>
<td>0.4083</td>
<td>0.0351</td>
</tr>
<tr>
<td>physical experience</td>
<td>0.0041*</td>
<td>0.0107</td>
</tr>
<tr>
<td>relationship w/ doctor</td>
<td>0.6132</td>
<td>0.0178</td>
</tr>
<tr>
<td>global QOL</td>
<td>0.3961</td>
<td>0.8657</td>
</tr>
</tbody>
</table>

* Significant at the 0.005 level.
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Another related issue relevant to QOL determinations in clinical trials is the evaluation of patient preferences. This is achieved by determining the relative weights, values, or utilities ascribed by patients to each dimension of QOL. The appraisal of a patient’s preference for one intervention or its consequences over another would thus be possible with a greater degree of certainty than that accomplished by a simple description of what those consequences are. Some work on utilities in the context of clinical trials of malignant glioma therapy has been done, although these have used medical professionals as proxies for patients in the assignment of utility values.

The most effective therapy that can currently be offered to a patient with malignant glioma is still palliative rather than curative. As has been pointed out by Schipper and Levitt, the definition, means preservation of QOL. In our quest to improve the survival time of patients with malignant glioma, the increasing consideration being given to the definition, assessment, and preservation of QOL is therefore appropriate.

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