Prospective analysis of health-related quality of life after surgery for spinal metastases

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Abstract

Purpose Most spinal metastases are detected late, and thus, the impact of treatment on the health-related quality of life (HRQOL) is an important consideration. This study investigated the HRQOL following surgery for spinal metastases.

Methods A prospective study of patients operated for symptomatic spinal metastases, at a single tertiary referral spine centre (2011–2013). Data were collected pre-operatively and up to 2 years following surgery (if alive). The HRQOL assessment was performed using recognised systems including the Frankel score (neurological status), EQ-5D, and the Oswestry Disability Index.

Results A total of 199 patients were studied (median age 65 years, 43% (86) F; 57% (113) M). The Frankel score improved significantly after surgery in 69 patients (35%), worsened in 17 (8%), with 20/39 patients regaining the ability to walk (51%). All the HRQOL scores improved significantly following surgery. The complication rate was 27% and median survival 270 days, and 44 patients (22%) survived at 2 years.

Conclusions This large prospective study showed that surgical treatment for spinal metastases significantly improved the HRQOL.

Keywords Health-related quality of life (HRQOL) · Spine metastases · Spine surgery · Frankel score · EQ-5D · Oswestry Disability Index

Introduction

The role of surgery in the treatment of spinal metastasis has varied in its prominence over the past several decades. Historically, patients underwent non-instrumented decompression and tumour resection. However, comparison of un-instrumented surgery with radiotherapy showed no difference in outcomes [1]. Thus, radiation became a standard treatment in all patients with spinal metastases, with surgery being reserved for rare occasions. Advances in surgical techniques and instrumentation have resulted in improved outcomes and a broader spectrum of interventions available to patients, supporting the role of surgery in the treatment of spinal metastasis [1–3].

The goals of surgery remain largely palliative and include the preservation or restoration of neurological function, mechanical stability and, rarely, oncologic control. Timely diagnosis and appropriate treatment selection are vital in optimising the outcomes of treatment of metastatic spinal disease [4]. Indications for surgery in spinal metastases include spinal instability requiring stabilisation with cement and/or instrumentation as well as urgent decompression with stabilisation for epidural cord compression.

Most spinal metastases are detected at later stages, when they are generally incurable. Thus, the impact of treatment on the HRQOL should be an even more important consideration in the choice of treatment. Studies of quality of life (assessed by patient recorded outcome measures) after surgery are only now starting to emerge [5, 6]. The purpose of this study was to investigate the HRQOL following surgery for spinal metastases. This was achieved by investigating the change in HRQOL (from pre-operatively to post-operatively and at final follow-up) in a prospective cohort of patients.
following surgical intervention for spinal metastases using recognised HRQOL questionnaires. Our hypothesis was that surgery in patients with spinal metastases does improve the HRQOL.

**Methods**

This was a prospective study of consecutive patients who were admitted for surgery to treat symptomatic spinal metastases and metastatic spinal cord compression (MSCC) at a single tertiary referral spine centre (2011–2013). For this study, the follow-up was from recruitment up to death or 2 years following surgery, whichever was sooner. Routine follow-up visits occurred at 6 weeks, 6 months, 1 year, and 2 years following surgery (or up to death if within 2 years). Indications for surgery included neurological deterioration and/or spinal pain due to mechanical instability from spinal metastases. Please see Fig. 1 for a case illustration. Patients with primary bone tumours of the spine were excluded.

The pre-operative data collected included patient demographics (age at surgery, gender), as well as the following:

- The revised Tokuhashi score [7]—an evaluation system for the prognosis of metastatic spinal tumours. The sum of the points of the following six items: general condition, number of extra-spinal bone metastases, number of metastases in the vertebral body, presence or absence of metastases to major internal organs, site of the primary lesion, and severity of palsy. Score 0–8; survival < 6 months, 9–11; survival 6–12 months, 12–15; survival > 1 year [7].
- The ASA (American Society of Anesthesiologists) score—a grading system for pre-operative health of the surgical patients, based on five classes (1–5): 1. Completely healthy, fit patient, 2. Mild systemic disease, 3.

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**Fig. 1** A 36-year-old gentleman who had undergone a thyroidectomy 2 years previously for follicular thyroid carcinoma presented with mechanical back pain with intact neurology (Frankel E). His MRI/CT scans showed isolated spinal metastases at L1 (a–c). Sixteen hours after embolisation, he underwent a spondylectomy and reconstruction (d, e). The procedure was uneventful, and he made an excellent recovery. Follow-up scans at 2 years (f, g) confirmed that he was free of recurrence.
Severe systemic disease that is not incapacitating, 4. Incapacitating disease that is a constant threat to life, and 5. A moribund patient who is not expected to live 24 h with or without surgery, metastatic tumor diagnosis, and surgical approach/type of operation.

The outcome data included:

- Neurological status (Frankel score)—a 5-point severity scale which is used to determine the severity of spinal-cord injuries. Patients are classified as complete (grade A), sensory only (grade B), motor useless (grade C), motor useful (grade D), or no neurological deficit/complete recovery (grade E) [8].
- The Karnofsky Performance Status—this is a method of quantifying the functional status of cancer patients. It is an 11-point rating scale which ranges from normal functioning (100) to dead (0) [9, 10].
- The Visual Analogue Score (VAS)—this is a pain rating score that is based on self-reported measures of symptoms that are recorded with a mark placed at one point along the length of a line—“no pain” on the left end (0) of the scale and the “worst pain” on the right end of the scale (10) [11].
- The EQ-5D score—this evaluates the quality of life across a wide range of disease areas. It comprises a short descriptive system questionnaire and a visual analogue scale. The descriptive questionnaire is measured by one question for each of the five dimensions: mobility, self-care, usual activities, pain/discomfort, and anxiety/depression. The score ranges from 0 for death to 1 for perfect health [12].
- The Oswestry Disability Index (ODI)—this questionnaire contains ten topics concerning intensity of pain, lifting, ability to care for oneself, ability to walk, ability to sit, sexual function, ability to stand, social life, sleep quality, and ability to travel. Each topic category comprises of six statements describing different potential scenarios in the patient’s life with the first statement scored zero and indicating the least amount of disability, and the last statement is scored 5 indicating most severe disability. The scores for all questions answered are summed (range 0–100), with zero is equated with no disability and 100 is the maximum disability possible [13].
- The Short Form-36 (SF-36)—a 36-item patient-reported survey of patient health status. It consists of eight-scaled scores: vitality, physical functioning, bodily pain, general health perceptions, physical role functioning, emotional role functioning, social role functioning, and mental health. Each scale is directly transformed into a 0–100 scale. A score of zero is equivalent to maximum disability, and a score of 100 is equivalent to no disability [14]. Post-operative complications and survival were also noted.

The data were analysed using SPSS version 24. All tests were two-sided; \( p \) values less than 0.05 were considered statistically significant. The median was used in all analysis (rather than mean), due to the skewed distribution of the data and not normally distributed (Shapiro–Wilk test). Thus, nonparametric tests were used (Wilcoxon signed-rank test for paired data; Mann–Whitney for comparing continuous data between two different groups and Chi-square tests for nominal data). Kaplan–Meier plots were produced to assess survival patients who were included from the date of surgery until 2 years following surgery (or up to death, if earlier).

Results

During the study period, 199 consecutive patients recruited into the study, from a total cohort of 248. Forty-nine patients were excluded (unwilling to participate/complete questionnaires (15); missed admissions (20); too unwell (14)).

The median age of patients was 65 years (13–89): 43% (86) female and 57% (113) male. Blood cell dyscrasias (\( n = 39, 20\% \)), prostate (\( n = 28, 14\% \)), breast (\( n = 26, 13\% \)), GI (\( n = 25,13\% \)), and renal/bladder (\( n = 24, 12\% \)) primaries accounted for the majority of metastases (almost 80%). Pre-operative data are shown in Table 1.

Neurological status

In terms of neurology, 39 (20\%) were unable to walk at the time of admission whilst post-operatively 20 of these (51\%) had regained the ability to walk; 19 remained non-ambulatory.

The Frankel grid in Fig. 2 shows the patients’ scores before (left-hand data) and immediately after (right-hand data) surgery. In 113 patients (57%), the Frankel score remained unchanged after surgery; for 69 patients (35\%) it improved significantly (\( p = 0.001 \)) compared to 17 patients (8\%) that worsened.

Karnofsky Performance Status

The median pre-operative Karnofsky physical functioning score was 46.9 (range 20–90), and this improved significantly to 56.5 (range 30–90; \( p = 0.001 \)) at 6 weeks. This improved for 127 patients (63.8\%), remained unchanged for 26 (13\%), and worsened for 46 (23.2\%). In those patients that survived 2 years, this showed a tendency to improve over time (see Fig. 3a).
Visual Analogue Scores

The median pre-operative VAS leg (or arm) pain score was 7 (range 0–10). This improved significantly to 2 at 6 weeks (range 0–8; \( p = 0.001 \)), and this was sustained over the 2 years of follow-up (\( p = 0.001 \)) (see Fig. 3b). The median pre-operative VAS back (or neck) pain score was 8 (range 0–10). This improved significantly to 3 at 6 weeks (range 0–8; \( p = 0.001 \)), and this was also maintained over the 2 years of follow-up (\( p = 0.001 \)) (see Fig. 3c).

EQ-5D

The median pre-operative EQ-5D score was 0.56 (range 0.516–0.826). This improved significantly to 0.67 (range 0.53–1; \( p = 0.001 \)) at 6 weeks and was sustained over the 2 years of follow-up, with the median score reaching a peak at 1 year post-operatively (see Fig. 3d).

Oswestry Disability Index

The median pre-operative ODI score was 66 (range 12–86); this improved significantly to 52 (range 0–100; \( p = 0.001 \)) at 6 weeks, and this was sustained over the 2 years of follow-up. This useful measure of function/disability also reached a peak at 1 year (see Fig. 3e).

SF-36

The median pre-operative SF-36 score was 56 (range 36–89), this improved significantly to 68 (range 16–98; \( p = 0.001 \)) at 6 weeks, and this was sustained over the 2 years of follow-up (see Fig. 3f).

Complications

Overall, there were 53 complications (27%) shown in Table 2. The most common of these were chest complications (\( n = 13, 7\% \)) and infection (\( n = 12, 6\% \)). We had four patients who had more than one complication. (Two patients had chest/respiratory complications and wound infection; one patient had wound infection and distal junction kyphosis; and one patient had wound infection and significant intraoperative bleeding). The overall median survival was 270 (12–2010) days. Using the Kaplan–Meier method, the survival plot was created and is shown in Fig. 4. In total, 44 patients (22%) survived at 2 years.
Table 2  Complications in all patients

| Type of complications                        | No. (%) |
|---------------------------------------------|---------|
| Chest                                       | 13 (7%) |
| Chest infection                             | 9       |
| Respiratory failure                         | 3       |
| Pleural effusion                            | 1       |
| Infection                                   | 12 (6%) |
| Superficial                                 | 8       |
| Deep                                        | 4       |
| Operative                                   | 8 (4%)  |
| Excessive bleeding (> 2 L)                  | 5       |
| Dural tear                                  | 3       |
| Other                                       | 7 (4%)  |
| Urinary retention                           | 3       |
| Cardiac event                               | 2       |
| Post-operative confusion                    | 1       |
| Hip fracture after fall                     | 1       |
| Hardware                                    | 5 (3%)  |
| Proximal/distal junctional failure          | 4       |
| Screw cut-out                               | 1       |
| Local disease progression                   | 4 (2%)  |
| GI                                          | 2 (1%)  |
| GI bleed                                    | 1       |
| Bowel perforation                           | 1       |
| In-hospital death                           | 2 (1%)  |
| Total no. of complications                  | 53 (27%)|
Discussion

This is one of the largest studies of a prospective group of patients from a single institution undergoing surgery for spinal metastases with comprehensive recordings of patient-reported outcome and quality of life scores. The results show that surgical treatment for spinal metastases does significantly improve the health-related quality of life.

As Choi and others have previously highlighted, survival and complication rates had been the key parameters by which surgery for spinal metastases was measured with very little data on patient-reported outcome measures for surgery for spinal metastases [6]. More studies on quality of life scores are now emerging. Falicov et al. [15] reported a small series of 85 patients who had improvements in pain, Health Utilities Index-3, EQ-5D, and European Organisation for Research and Treatment of Cancer (QLQ-C30) questionnaire up to 1 year after surgery. This study has additionally shown these improvements occur in a range of functional outcome scores. Furthermore, there were 39 patients of whom regained the ability to walk after surgery. It was also found that the Karnofsky Performance Status improved progressively over 12 months after surgery, as well as the other functional outcome scores (ODI, SF-36) reaching a peak at 1 year.

Complication rates occurred in one quarter of all patients and are comparable to other studies [6]. The systemic nature of metastatic disease does, of course, mean that patients are indeed more susceptible to post-operative complications during convalescence. Careful patient selection for surgery remains paramount, otherwise post-operative complications may offset the intended benefits of surgery.

Surgery does not aim to cure the disease, but to improve and maintain HRQOL, keeping patients out of hospital, walking and independent with little pain [16]. Improvements in surgical, medical, and radiation techniques have significantly improved the quality and duration of life for patients with cancer. Modern treatment of metastatic spinal tumours should involve a multidisciplinary approach with spinal specialists, oncologists, radiologists as well as the palliative/rehabilitation support teams. Whilst all these specialist areas have improved their services, the goal of treatment of metastatic spinal pathologies remains largely palliative. The median survival in this study was 9 months, with 22% of patients surviving 2 years with better HRQOL scores than pre-operative for the duration.

There have been a few studies looking at the "mean clinically significant difference" with the quality of life and outcome scores utilised in this study [17–19]. Of those used, the ODI score, although improving significantly, did not reach the mean clinically significant improvement criteria of 20% quoted in these studies. This is perhaps a limitation of the use of the ODI in this setting.

"Heterogeneity" of different procedures for spinal metastases is clearly a limitation of this study and thus collaborating with other centres (to increase patient numbers) is clearly important as this will allow a comparative analysis of different operations. It is worth noting that the study did not assess the outcome of patients who were treated without surgery, and therefore, these findings cannot be generalised to all patients with metastatic spine tumours. The surgeon’s decision-making on whether to go ahead with surgery or not depends on (prognostic) decisions from the surgical and oncological teams including life expectancy and, of course, the wishes of the patient and discussion with their family. We can, however, say with some confidence, that in appropriately selected patients, surgery has provided significant improvements in pain, functional status and health-related quality of life.

Conclusion

In summary, this study has reported on a large prospective series of patients undergoing surgery for spinal metastases. The results have shown that there were significant improvements following surgery using the HRQOL scores.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

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