Original Article

A Royal College of Radiologists National Audit of Radiotherapy in the Treatment of Metastatic Spinal Cord Compression and Implications for the Development of Acute Oncology Services

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Abstract

Aims: To audit the current use of radiotherapy in UK cancer centres for the treatment of metastatic spinal cord compression against national standards that seek to optimise functional and quality of life outcomes.

Materials and methods: A Royal College of Radiologists prospective national audit of patients treated with radiotherapy in UK cancer centres was carried out over a 3 month period between September and December 2008, with a repeat audit carried out in August 2012.

Results: Five hundred and ninety-six cases were received from 42 cancer centres (74%) in 2008, with data from 323 cases received from 52 (90%) centres in 2012. Ninety-three per cent (358) of patients had a diagnostic magnetic resonance imaging scan carried out within 24 h of referral for radiotherapy in 2008 compared with 205 patients (97%) in 2012. One hundred and eleven (32%) good prognosis patients were discussed with spinal surgeons; only 10 good prognosis patients were recorded as proceeding to surgery in 2008. This improved in 2012, with 94 (41% of good prognosis patients recorded as having been discussed with nine proceeding to surgery). Sixty-nine per cent of paraplegic patients in 2008 received multiple fractions of radiotherapy, which was similar to 2012 when 62% received more than a single fraction. A metastatic spinal cord compression co-ordinator was available in just over 50% of cases (164/323) and was involved in patient management in 26% of cases in 2012.

Conclusion: Despite level 1 evidence of the superior functional outcome and survival benefit for surgery, few good prognosis patients were recorded as having been discussed with surgeons and even fewer proceeded to surgery.

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Key words: Metastatic spinal cord compression; MSCC; radiotherapy

Introduction

Metastatic spinal cord compression (MSSC) is a debilitating and common complication of cancer, occurring in 5–14% of cancer patients [1]. Studies have consistently shown that MSCC is diagnosed late in the evolution of a compressive lesion. Recovery of mobility is unlikely if paraplegia is already established at diagnosis, necessitating 24 h nursing care and prolonged hospitalisation, often for the remainder of the patient’s illness [2–5].

A prospective audit of MSCC reported by Levack et al. in 2002 [6] showed that 82% of patients were unable to walk at diagnosis, despite a history of pain for about 3 months and weakness and/or sensory problems for some time (median 20 and 12 days, respectively) before diagnosis. Although patients often reported early warning symptoms, the diagnosis of MSCC was often delayed. An audit of patients treated in Northern Ireland in 2003 confirmed a delay in diagnosis and onward referral to radiotherapy, with only 36% of patients referred for oncology assessment within 24 h of diagnosis of MSCC and 55% of those receiving radiotherapy starting treatment within 24 h of magnetic resonance imaging (MRI) diagnosis [7]. In August 2005, the benefit of direct decompressive surgery followed by post-operative radiotherapy was shown in a randomised phase III study reported by Patchell et al. [8]. This study was...
stopped early as significantly more patients in the surgery and postoperative radiotherapy group (84%) compared with the radiotherapy-alone group (57%) were able to walk after treatment \((P = 0.001)\). Surgical patients remained ambulant for longer (122 versus 13 days) and of those unable to walk, 62% of the surgical group compared with 19% of the radiotherapy group regained the ability to walk.

Recognising the importance of early diagnosis and treatment to optimise functional outcomes, the Royal College of Radiologists (RCR) published guidelines for the management of MSCC in July 2006. This guidance recommended that the use of radiotherapy in established paraparesis should be restricted to a single fraction, if indicated to improve pain control, as neurological improvement was unlikely [9].

The National Institute for Health and Clinical Excellence (NICE) published guidance for the management of MSCC in November 2008 [10]. There are clear recommendations for timely access to MRI, appropriate surgery and radiotherapy, actively managed by an MSCC co-ordinator. As part of the development and implementation of Acute Oncology Services, cancer networks have been tasked with developing referral and care pathways that optimise outcomes for all patients with MSCC and identify those at high risk of MSCC for early intervention. The current repeat audit aims:

- To continue to benchmark the management of MSCC throughout the UK against national standards and assess if and where improvements have been made throughout the pathway.
- To assess the appropriate use of radiotherapy and hospital resources in accordance with RCR guidance [9].
- To assess critical components of the care pathway for ‘good prognosis patients’, namely access to prompt MRI, surgical assessment and treatment and fractionated radiotherapy.
- To evaluate the management of ‘poor prognosis patients’ who should not receive fractionated radiotherapy, which often results in inappropriate hospitalisation in oncology units.
- To engage with the multidisciplinary team, i.e. radiology, spinal and neurosurgeons, palliative care physicians and nurses, physiotherapy and occupational therapy to optimise functional outcome and appropriate care.

Materials and Methods

The original audit collected prospective data on all patients with a diagnosis of MSCC receiving radiotherapy in all UK National Health Service cancer centres for a 3 month period from 15 September 2008 to 14 December 2008, and assessed compliance with the following audit criteria derived from the RCR dose-fractionation guidance published June 2006. Demographic data, including the age and gender of the patient, source of referral, tumour site and site of cord compression, were collected, as was the place of discharge.

- Patients with symptoms suggestive of spinal cord compression should have access to an urgent MRI (within 24 h of presentation and referral for radiotherapy).
- Patients immobile for <24 h or ambulant or performance status 0, 1 or 2 (‘good prognosis’) should be discussed with neuro/spinal surgeons.
- Radiotherapy, if prescribed, should start within 24 h of diagnosis.
- Fractionated treatment should be prescribed for patients immobile for <24 h or ambulant and performance status 0, 1 or 2.
- Poor prognosis patients, i.e. those with established paraplegia for >24 h should only receive radiotherapy for pain relief.

The repeat audit prospectively collected data for all patients presenting to radiotherapy centres with MSCC between 1 and 31 August 2012 with the intention that these results could inform National Cancer Research Institute (NCRI) meetings later that year. With increasing collaboration with spinal surgical colleagues, further information was requested to allow calculation of the Tokuhashi score. Clinical outcomes at 6 months were requested in the 2012 audit.

A specifically developed web-based data form was constructed using Snap 9 Professional survey software. This was modified for the 2012 audit. The data form was circulated for comment to the RCR Clinical Oncology Audit Committee, the NICE Spinal Working Group and the Society and College of Radiographers and, after revision, piloted in four centres. Clinical oncology audit leads acted as links between the RCR and participating centres. Individual centres were given the opportunity to comment before publication.

Analysis

Data analysis was undertaken using Microsoft Office Excel 2007. Compliance with each of the audit criteria was calculated using percentages with 95% confidence intervals. Cases in which relevant information was unavailable were excluded from these calculations.

Results

In the first audit, data for 596 cases of MSCC were received from 42 of 57 (74%) UK radiotherapy centres. The number of cases received from contributing centres varied from two to 41 (median 11). There were 401 men and 195 women. In the repeat audit, data from 323 cases were received from 52 of 58 (90%) cancer centres; 204 men and 92 women in patients where gender was recorded. An MSCC co-ordinator was available in just over 50% of cases (164/323) and involved in patient management in 26% of cases in 2012.

Figure 1 shows demographic data. Figure 1A describes the distribution of primary sites in the patients with a known previous diagnosis of cancer at presentation. As
expected, the most common tumour sites were prostate, breast and lung cancer, with a smaller number of gastrointestinal cases and haematological malignancies.

In total, 290 patients (90%) had MRI carried out in 2012 compared with 86% in 2008. Of those who did not in 2012, two had a pacemaker, 18 computed tomography confirmation, one was too sore, with no information available for the remainder. Ninety-three per cent had MRI within 24 h of suspected MSCC in 2008. This had increased to 97% in 2012; 58/323 (18%) had MRI at the weekend or outside normal hours, compared with 86/596 (14%) in 2008.

The source of the initial presentation with a clinical diagnosis of MSCC was available in 572 cases in 2008 and 311 cases in 2012, with most patients presenting to district general hospitals rather than specialist units (Figure 1B).

Based on 86% (512) of patients with relevant dates available, the median time from the date of referral to oncology with suspected MSCC to the first radiotherapy...
treatment was 1 day (interquartile range 0–2 days) in 2008. Three hundred and sixty-nine (72%) of these patients started radiotherapy within 24 h. In 2012, the median time from the date of referral to radiotherapy starting was 1 day (interquartile range 0–1 days), with an improvement in patients who started treatment within 24 h; 243 (81%).

Eastern Cooperative Oncology Group (ECOG) performance status and neurological status were collected to assess the appropriateness of subsequent surgical and radiotherapeutic management. ECOG performance status was available in 84% of cases in 2008 and 86% of cases in 2012 (Figure 1C). Figure 1D shows the neurological status of all patients.

In total, 148 of 596 (25%) cases in 2008 were recorded as having had surgical intervention discussed with the spinal surgical team compared with 104 of 323 (32%) in 2012. Figure 2 illustrates the relationship between ECOG performance status and surgical referral. In 2008 only 79 (29%) of 277 patients with ECOG performance status 0–2 (potentially suitable for surgery) were recorded as having been discussed with the surgical team. This had improved in 2012, with 56 of 158 (35%) of performance status 0–2 patients recorded as having been discussed. Fifty-one of 222 (23%) poor performance status patients (performance status 3–4) in whom surgery was unlikely to be beneficial were also referred to the surgical team in 2008, which again was similar in the repeat audit, when 43/119 (36%) of poor performance patients were discussed. Of the 148 cases in 2008 discussed with the surgical team, only 15 cases were recorded as having surgical intervention. Ten cases in 2012 proceeded to surgery.

In 2012, further information was collected to allow calculation of the Tokuhashi score by the data manager. The Tokuhashi score takes into consideration performance status, the presence of extraspinal bone metastasis, the number of vertebral levels involved, extension of metastasis to an internal organ, neurological deficit and type of primary tumour to allow the prediction of prognosis [11], with a score of 9–15 indicating that a better prognosis correlates well with outcomes. Table 1 illustrates the calculated scores. Of those patients with relevant data available, 39/92 (42%) patients with a Tokuhashi score of 0–8 were referred for a surgical opinion and 28/62 (45%) patients with a Tokuhashi score of 9–15 were referred. No patients with a Tokuhashi score of 0–8 underwent surgery and 5/66 (8%) patients with a Tokuhashi score of 9–15 underwent surgery. Eighteen of 57 (32%) patients with a Tokuhashi score of 0–8 were alive at 6 months and 15/25 (60%) patients with a Tokuhashi score of 9–15 were alive at 6 months.

In 2012, 81% of patients received radiotherapy within 24 hours of referral compared with 72% in 2008. The reasons for the delay of more than 24 h in radiotherapy starting are listed in Table 2. Note that more than one answer was permitted.

In both series, the dorsal spine was the most commonly treated area, followed by lumbar then cervical spine. There were a number of fractionation schedules in both groups from those who received a single fraction to up to 25 fractions. Figure 3 shows fractionation schedules in both groups. Sixty per cent of paraplegic patients in 2008 (Figure 3A) received five or more fractions of radiotherapy, which was very similar to 2012 (Figure 3B), when 51% received five or

![Image](https://example.com/image.png)

**Fig 2.** Percentage of patients discussed with a surgeon by Eastern Cooperative Oncology Group performance status at initial assessment and year of audit.
more fractions. Considering those patients who could walk unaided in 2008, 10% received one fraction of radiotherapy, which was very similar to 2012, when 11% of those who could walk unaided received a single fraction.

Figure 1E shows the place of discharge, if known. Forty-one patients (7%) died in a cancer bed in 2008, 30 of these received more than one fraction. In 2012, 16 (5%) patients died in a cancer bed; 12 had received more than one fraction.

National compliance with each of the audit criteria is described in Figure 4. In this audit, there was reasonable access to timely MRI (97%) and radiotherapy (81%), with improvement in both in the second audit. Non-overlapping confidence intervals indicate that in the case of the latter, the improvement was statistically significant. The rate of referral for surgical assessment of good prognosis patients, based on neurological status, performance status or estimated prognosis, remains poor. It is striking to note that of these patients, only 10 referred for surgical assessment in 2008 and nine referred for surgical assessment in 2012 proceeded to surgery. Again overall, there was poor compliance with the recommended single fraction of radiotherapy in poor prognosis patients.

Table 1
Tokuhashi scores in 2012

<table>
<thead>
<tr>
<th>Tokuhashi score</th>
<th>Frequency (n = 323)</th>
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<tr>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>10</td>
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<tr>
<td>3</td>
<td>11</td>
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<tr>
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<td>0</td>
</tr>
<tr>
<td>15</td>
<td>2</td>
</tr>
<tr>
<td>No information</td>
<td>137</td>
</tr>
</tbody>
</table>

In 2013, centres were re-contacted to obtain information on outcomes at 6 months. This was available on 146 patients (45%). Of these 146, 48 were alive at 6 months and 98 had died. These figures are reflective of the general poor prognosis of patients with MSCC [12,13]. We have no information on the other 55% and it is difficult to make any assumptions on their outcome.

Discussion

Vertebral bony metastases occur in 3–5% of all cancer patients [10]. Recent advances in systemic therapy have improved survival for those living with metastatic disease. For example, the 3 year survival of women with metastatic breast cancer is now 20% [14] and up to 30% of men with metastatic bony disease from prostate cancer survive 5 years or more [11]. Thus, effective management of MSCC as an oncological emergency is essential to preserving functional outcome, quality of life and survival in this patient group.

This audit and re-audit give a good representation of current practice across the UK. Response rates from radiotherapy centres were good, at 74% in 2008 and 90% in 2012, which is sufficient to assume negligible response bias, and is greater than the average of 80% for similar RCR audits over recent years. However, follow-up mortality data were less complete, with information available on fewer than 50% of patients. To encourage high response rates there were inevitable omissions in the data collected. For example, this audit did not address referral to rehabilitation services. Neither was information on functional outcome collected, as it was felt that it may prove difficult to obtain due to discharge to peripheral hospitals and discourage data collection. Despite recognised limitations, this remains the only comprehensive national dataset on the management of MSCC.

The first audit accrued 596 patients over 3 months, roughly 200 patients per month. The second audit accrued 323 patients in 1 month. Despite the 2012 audit being carried out in August, there was no evidence that this had a detrimental effect on response rates. In fact, response rates had improved in 2012. To allow correlation between the two time periods, a multiplication factor of 3 was applied to Table 2

<table>
<thead>
<tr>
<th>Reason</th>
<th>Number of responses (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Awaiting decision from neuro/spinal surgeons</td>
<td>33 (9)</td>
</tr>
<tr>
<td>Awaiting magnetic resonance imaging</td>
<td>46 (13)</td>
</tr>
<tr>
<td>Cancer centre bed not available for patient transfer</td>
<td>23 (6)</td>
</tr>
<tr>
<td>No out of hours or weekend radiotherapy service available</td>
<td>11 (3)</td>
</tr>
<tr>
<td>Oncology team not informed by referral source</td>
<td>63 (18)</td>
</tr>
<tr>
<td>Patient too ill</td>
<td>13 (4)</td>
</tr>
<tr>
<td>Other</td>
<td>69 (19)</td>
</tr>
<tr>
<td>No information</td>
<td>102 (28)</td>
</tr>
</tbody>
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the 2012 data to obtain figures for 3 months. With this there seems to be a mean increase of about five referrals per centre, which may suggest an increase in the diagnosis of MSCC, possibly due to increased availability of imaging. Access to MRI seems to be improving, with 93% having had an MRI within 24 h of suspected MSCC in 2008, increasing to 97% in 2012 and encouragingly with increased availability outside of working hours.

One of the key findings of both the audit and the re-audit is the lack of documented surgical referral for good prognosis patients, despite the publication in 2005 of level 1 evidence supporting the benefit of decompressive surgery in addition to radiotherapy [8] and subsequent publication of NICE guidance in 2008. Overall, only 32% of these good performance patients were recorded as having been discussed with spinal surgeons and of these only 10 proceeded

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**Fig 3.** Number of fractions by ability to walk at clinical diagnosis of metastatic spinal cord compression in 2008 (A) and 2012 (B).
with surgery in 2008. This improved marginally to 41% in 2012. The finding of a low rate of referral to surgical units is in keeping with the previous results of a NICE questionnaire to cancer centres that indicated that less than 25% of patients with MSCC were assessed by a surgical team, but that more than 50% of those assessed proceeded with surgery, with the most common tumour being breast cancer [10]. However, in our audits, only 9–10% of patients discussed actually proceeded to surgery. This may be due to inappropriate referral of poor prognosis patients. With more robust guidelines, the quality of referral should improve, which should improve surgical rates.

Patients may present from many referral sources. This may result in a delay in diagnosis, organising and accessing MRI and actioning results. Functional outcomes of MSCC after treatment are dependent on the duration and extent of neurological deficit at presentation, with few patients with established paraplegia for more than 24 h regaining mobility [2–5]. No randomised clinical trial data exist to determine the fractionation schedule in all patients and the results of the SCORAD III trial are eagerly awaited. This audit did not collect information on entry to any clinical trial. However, in August 2012, only 12 patients were entered into the SCORAD III trial; therefore it is unlikely that this has greatly influenced the outcomes of the audit. In a review by Prewett et al., longer course radiotherapy does not seem to offer improvement in neurological outcome or survival when compared with shorter regimes. However, there may be an advantage in terms of local control and in field recurrences and therefore may be appropriate in patients with estimated survival greater than 6 months [15].

Fractionated radiotherapy is recommended for performance status 0/2 patients and a single fraction for pain control only in performance status 3–4. However, both audits have shown poor compliance with this recommendation. Of patients who were paraplegic at presentation, 69% in 2008 and 62% in 2012 received multiple fractions of radiotherapy. In patients still walking unaided or with help, 13% in 2008 and 17% in 2012 received only a single fraction.

Both the audit and the re-audit highlight the need for robust clinical protocols and development of patient care pathways so that appropriate clinical decisions, including appropriate surgical referral and optimal end of life care, are available to those patients for whom the development of MSCC is a terminal event. Comprehensive discharge planning and effective co-ordination and communication with palliative care teams and primary care services in a timely manner is essential, given the limited survival of most of these patients.

Key priorities specified in the NICE MSCC guidance are that each cancer network should ensure ‘commissioning of appropriate services to ensure efficient diagnosis, treatment, rehabilitation and care of patients with MSCC. An MSCC co-ordinator should be available to register and document initial patient information and act as a primary point of referral to access specialist radiology, spinal surgical and radiotherapy clinical input. It is the responsibility of each cancer network to provide 24 h access to urgent MRI, access to surgical intervention before any further neurological deterioration and access to radiotherapy simulation and treatment 7 days a week in those unsuitable for surgery.
Late diagnosis of MSCC remains a challenging clinical problem. NICE guidance recommends providing patients with bony metastases and those at high risk of developing bony metastases with written information about the early warning signs of MSCC and how to seek urgent help. It is hoped that a future audit will capture information on the education of at risk patients.

The National Chemotherapy Advisory Service has recommended a more systematic approach to the management of cancer-related emergencies, such as MSCC, and this has been embodied in the concept of an Acute Oncology Service. Since the initial audit was carried out, acute oncology measures, including MSCC, have been published (7 April 2011) for the Manual of Cancer Standards. The measures specify a network MSCC group and a designated MSCC lead reporting to a Network Acute Oncology Group (NAOG). Furthermore, the NAOGs are tasked with providing a network MSCC senior clinical advisor service available 24 h a day, 7 days a week, MSCC co-ordinators to act as a single point of referral into a defined MSCC care pathway and collecting audit data on timeliness to imaging, timeliness to definitive treatment, functional outcomes and mortality.

Conclusions

Despite improvements in MRI provision and oncology presence in cancer units and radiotherapy centres, these data still highlight delays along the entire care pathway for MSCC. Nine years after the publication of level 1 evidence supporting surgical intervention, very few patients received surgery as part of their management. Both audits highlight the ongoing need for accurate recording of patient performance status, neurological status, prognosis and surgical decisions in radiotherapy notes so that the decision to treat with radiotherapy alone can be justified. The RCR is now working closely with the specialist spinal surgical associations and other key stakeholders to develop robust audit methodologies and registries for the collection of prospective outcome data. It is hoped that with comprehensive prospective national data collection and the current implementation of NICE MSCC guidance by cancer networks will see significant improvements in the care of patients with MSCC.

Acknowledgements

We are indebted to the audit leads and data collectors in the cancer centres for their meticulous and conscientious approach to data collection, with minimal additional resources, without whose help, this project could not have been completed.

References