FULL TITLE

Survival of patients undergoing surgery for metastatic spinal tumours and the impact of surgical site infection

RUNNING TITLE

SSI and survival in spinal tumour patients

AUTHORS

Ross A. Atkinson[1,2], Benjamin Davies[1], Anna Jones[1], Dmitri van Popta[1], Karen Ousey[3], John Stephenson[3]

[1]Greater Manchester Neurosciences Centre, Manchester Academic Health Science Centre, Salford Royal NHS Foundation Trust

[2]Faculty of Medical and Human Sciences, Manchester Academic Health Science Centre, The University of Manchester

[3]School of Human and Health Sciences, University of Huddersfield

CORRESPONDING AUTHOR:

Ross A. Atkinson, PhD

Honorary Research Associate,

Institute of Inflammation and Repair, Manchester Academic Health Sciences Centre, University of Manchester

Email: ross.atkinson@manchester.ac.uk

SUMMARY

Background

Patients with metastatic spinal tumours have a limited prognosis. Surgical complications which may result in prolonged hospitalisation or readmission are highly undesirable. Surgical site infection (SSI) is one such complication which can, in extreme cases, lead to death.

Aim

To assess the impact of SSI on patient survival after surgery for spinal metastases.

Methods

Demographic, operative and survival data were collected on 152 patients undergoing surgery for spinal metastasis at a large UK tertiary referral centre. American Society of Anesthesiologists (ASA) grade and the Revised Tokuhashi Score (RTS) were determined as measures of health status and prognosis, respectively, at baseline. A semi-parametric Cox proportional hazards survival analysis was used to assess the relationships between covariates and survival.

Findings

Seventeen patients (11.2%) experienced SSI. Overall, median survival time from operation was 262 days (95% CI: 190-334 days) and 12 month survival was 42.1%. RTS (p<0.001; hazard ratio 0.82; 95% confidence interval: 0.76-0.89) and ASA grade (p=0.028; hazard ratio 1.37; 95% confidence interval: 1.03-1.82) were significantly associated with survival, with better survival found in patients with higher RTS and lower ASA scores. Infection status was of substantive importance, with better survival in those without SSI (p=0.075).

Conclusion

Twelve month survival in patients undergoing surgery for spinal metastasis is approximately 42%. RTS and ASA scores can be used as indicators of patient survival either in combination or individually. While SSI has some negative impact on survival, a larger study sample would be needed to confirm whether this is statistically significant.

Key Words

Metastasis; Spine; Surgical site infection; Survival.

INTRODUCTION

Surgical intervention for patients with metastatic spinal tumours is indicated in patients with pain, instability, or neurological compromise who have a life expectancy exceeding 3 months, according to the National Institute of Health and Care Excellence (NICE) Clinical Guideline 75[1]. Surgery aims to prevent or relieve pain, and symptoms associated with mechanical instability and neurological compromise [2, 3]. Complications which jeopardise the success of the operation are therefore highly undesirable. Surgical site infection (SSI) is one such complication, being the third most commonly occurring healthcare-associated infection (HAI) in England (accounting for approximately 16%). SSI has a significant impact on the management of patients undergoing spinal surgery, the length of time they spend in hospital, and how much money is spent on additional treatment [4].

Although there is little evidence available to demonstrate a direct link between SSI and mortality specifically in spinal tumour patients, it has been suggested that those suffering SSI as a result of several types of procedure are overall twice as likely to die and 60% more likely to spend time in the intensive care unit [5]. Determining the risk of SSI and its potential impact on mortality in patients undergoing specialist surgical treatment will further highlight the importance of this complication and the need to implement preventative measures.

A significant proportion of patients presenting with spinal metastases are unaware that they have a primary tumour, with symptoms of spinal cord compression being the first indication of the disease. Others, however, are known to be suffering from cancer and receiving treatment. Baseline health status for those undergoing surgery can vary substantially between patients. The Revised Tokuhashi Score (RTS) is a published system recommended by NICE as a tool to determine eligibility for surgery, as it is a recognised as being able to accurately predict survival [6]. However, some healthcare providers do not use the RTS to strictly determine which patients should be offered an operation because not all have a bone scan or a staging computed tomography (CT) pre-operatively, and because of the perceived palliative benefits of surgery even in those who might have a life expectancy less than three months. Generally, the RTS suggests that those with a score of 8 or less have a predicted survival of up to 6 months, meaning that conservative or palliative treatments are indicated. Those with scores of 12 to 15 have a predicted survival of more than 12 months, meaning that excisional surgery may be appropriate. Those with a RTS from 9 to 11 are more often suitable for palliative surgery rather than excisional surgery. Given that RTS appears to be useful in predicting outcomes for patients with spinal metastasis, this score could be used to standardise patients at baseline (i.e. the time of their operation) when investigating whether there is an association between SSI and mortality. Similarly, the American Society of Anesthesiologists (ASA) grade is a recognised scoring system which can be used to determine patient fitness for surgery [7]. ASA grade is relatively more simple than the RTS to determine, and is routinely recorded prior to surgery in the majority of cases. Its use is also recommended by NICE in determining the appropriateness of surgery for patients with spinal tumours.

Therefore, the aim of this study was to assess the impact of SSI on patient survival following surgery for spinal metastatic tumours, after controlling for baseline fitness using both RTS and ASA grades.

METHODS

This was a sub-study of an ethically approved case note review of all adult patients (aged ≥18 years) who had undergone surgical treatment for spinal metastatic tumours at Salford Royal NHS Foundation Trust (SRFT) between 1st January 2009 and 31st December 2012 [8]. Demographic (age, sex), operative (date of operation, type of procedure, presence or absence of SSI) and survival data (date of death, if applicable) were collected. Final follow up assessment was conducted on 15th July 2014. In addition, the RTS was determined retrospectively using available medical records and ASA grade was obtained from the surgical documentation. RTS and ASA were determined to give an indication of health status at baseline (i.e. the time of surgery).

Definition of SSI

The presence or absence of a SSI (superficial or deep) was defined using the criteria set out by Public Health England [9], which is largely based on the definitions published by the Centers for Disease Control and Prevention (CDC) and the work of Horan et al. [10]. SSIs were classified by the SSI surveillance nurse for the neurosurgery department, as per standard routine for the reporting of SSIs through the hospital SSI Surveillance Service.

Data Collection

Data were collected from existing patient case notes and associated medical records (e.g. medical images) and were anonymised prior to analysis; no contact with patients or relatives was required for additional data collection. RTS was calculated based on relevant clinically available data; ideally, RTS would be determined pre-operatively in order that this score can be used to assist in assessing patients' suitability for surgery. However, RTS is not formally recorded routinely at our institution and so this score was determined retrospectively based on the method described by Tokuhashi et al. [6] where possible, with the exception of instances where the number of extra-spinal bony metastases was unavailable from bone scintigraphy or magnetic resonance imaging (MRI). In these cases, staging CT was used. ASA grade was recorded directly from the surgical pathway documentation. All patients were followed up at at least one year post-surgery. Data relating to infection status and survival were collected at this time point.

Statistical Analysis

Overall survival was assessed using the Kaplan-Meier method. A semi-parametric Cox proportional hazards survival (time-to-event) analysis was undertaken to assess the relationships between covariates and survival.

RESULTS

A total of 152 patients (77 females and 75 males) underwent surgery for spinal metastasis over the four year study period. Mean age at operation was 60.5 years (SD 12.9 years). Seventeen patients (11.2%) experienced SSI (14 superficial and 3 deep). At the time of last follow up, 117 patients had died. Median survival time from operation for the whole cohort was 262 days (95% CI: 190-334 days). This equates to 42.1% at 12 months, and 19.6% at five years. Median survival time for patients experiencing SSI was 135 days (95% CI: 62-208 days), and for those without infection, 276 days (95% CI: 183-369 days).

The assumption of proportional hazards was found to be tenable, and measures of patient fitness were not excessively correlated. The Cox analysis found both RTS and ASA score to be significantly associated with survival (Table 1), with better survival found in patients with higher RTS and lower ASA scores.

Direction of approach was not considered as a candidate factor due to only one patient with an SSI experiencing an anterior approach, and less than 10% of patients in total experiencing an anterior approach. Hence direction of approach does not adequately distinguish between either cases, or between controls and was thus unsuitable as a candidate variable. All cases (infection and non-infection) were instrumented and so this too was not included in the analysis.

[INSERT TABLE 1]

Survival curves for RTS and ASA are shown in Figures 1 and 2. Each additional point on the RTS scale was associated with an 18% lowered hazard of death ($p<0.001$). Each additional point on the ASA scale is associated with a 37% raised hazard of death ($p=0.028$).

[INSERT FIGURES 1 AND 2]

Infection status was found to be of substantive importance, with better survival shown by those without SSI ($p=0.075$) (Figure 3). Age at the time of surgery was not substantively related to survival ($p=0.299$).

[INSERT FIGURE 3]

DISCUSSION

The results of this study suggest that the median length of survival from the date of surgery for spinal metastases is approximately 8.6 months. This is comparable to figures previously reported in the literature [11, 12]. Twelve month survival in the present cohort was 42.1% overall (29.4% in those with SSI and 43.7%in those without SSI.

As expected, both ASA grade and RTS predicted survival effectively in patients in this study. When using these scores to control for baseline health status, patients experiencing SSI survived on average half as long as those without SSI (though the association between infection and survival was substantive). The low number of cases represented in this study may be a limiting factor and a reason why this association was not observed to be significant. Nevertheless, this study describes the contemporary SSI rate in this patient group at a large UK specialist spinal centre, and is one of the first to demonstrate a relationship between SSI and mortality in this type of patient.

It has been estimated that between 38 and 75% of deaths in patients with SSI are attributable to infection itself [13, 14], with SSI being an independent predictor of mortality. Other studies have suggested that the type of surgery, and whether SSIs are deep/organ space have some bearing on the level of contribution of infection towards death [15]. While this seems logical, it is impossible in this study to indicate whether the type of infection (superficial or deep) had any effect on survival, given that only three cases were documented as being deep. A larger case series would be needed to determine whether additional factors such as this played an important role in affecting survival outcome.

It is suggested that there are approximately 4,000 cases of metastatic spinal cord compression diagnosed each year in England and Wales [1], though this is likely to be an underestimate. Surgery is generally undertaken as a palliative measure to relieve pain and stabilise the spine to prevent further neurological damage. Estimating that only around 20% of these will undergo surgery (Richards, personal communication), and based on the 11.2% infection rate demonstrated in this study, 90 patients per year could be at risk of developing SSI. Given the differential in life expectancy demonstrated in this study between patients with and without SSI (141 days shorter in SSI patients), theoretically, this equates to approximately 12,600 days (34.5 years) of life lost which relates to the onset of SSI for just those treated surgically over the period of one year. This, coupled with the distressing consequences of infection (prolonged in-patient hospitalisation, isolation away from home, additional treatments) and the inevitable economic costs associated with SSI [4], can be exceedingly frustrating for a service under pressure to provide better care at a lower cost.
Scrupulous peri-operative practice and the standardisation of effective processes in the operating theatre may go some way to improving outcomes in terms of SSI rates [16-18]. In addition, effective

surgical work-up and the notion of ‘prehabilitation’ in the pre-operative period may better prepare some elective spinal surgery patients physiologically to improve some outcomes [19]. However, there is little evidence to support this approach in reducing post-operative complication rate. Furthermore, in urgent cases – such as those needing surgery for spinal tumours – this window of opportunity is generally not available to the care team, meaning that extra preventative measures are highly desirable and clearly warranted. This is especially so in cancer patients given that they are at increased risk of SSI, due largely to their immunosuppressed state [20, 21].

The results provided by this study may be useful during the consenting process for spinal surgery. The appropriateness and quality of information patients receive prior to their operation, about the procedure and its associated risks are of utmost importance when ensuring their decisions are fully informed and their expectations managed. Thus, patients have a right to know about the implications of SSI. Despite this, it is evident from previous studies that many patients are poorly informed about SSIs; some are unable to recognise the signs and symptoms of an infection or unaware of the causes or the risk factors of SSI [22]. This low level of awareness about SSI, coupled with the potential for such devastating effects on quality of life and clinical outcome indicates that greater attention should be paid to this complication across the board. Statistics relating to individual departments, such as those presented in this study, could go some way to educating both staff and patients of the institution, in an effort to emphasise risk factors for SSI, what can be done to combat them, and the importance of their consequences. It is hoped this would then translate into the adoption of processes – on the part of both patient and care team – which drive down the incidence of SSI.

CONCLUSIONS

One-year survival in patients undergoing surgery for spinal metastases is approximately 42%. Either or both of RTS or ASA scores can be used as reliable indicators of survival in these patients. While SSI has some negative impact on survival, a larger study sample would be needed to confirm that this is a statistically significant association. The evidence provided by this study may raise awareness of the importance of SSI as a complication of surgery for spinal metastasis.

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