The cost effectiveness of stereotactic radiosurgery versus surgical resection in the treatment of solitary metastatic brain tumors

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Record Status

This is a critical abstract of an economic evaluation that meets the criteria for inclusion on NHS EED. Each abstract contains a brief summary of the methods, the results and conclusions followed by a detailed critical assessment on the reliability of the study and the conclusions drawn.

Health technology

Stereotactic radiosurgery

Type of intervention

Treatment.

Economic study type

Cost-effectiveness analysis

Study population

Patients with metastatic tumours.

Setting

The analysis was based on an institutional setting and the economic study was carried out in the United States.

Dates to which data relate

Effectiveness analysis data was taken from the period 1974-94.

Source of effectiveness data

The effectiveness data was taken from a review/synthesis of previously completed studies.

Modelling

The mix of services provided and the resources used during typical treatment scenarios for each modality were modelled by the authors.

Outcomes assessed in the review

The outcome measure used in the review was 'life years', without any adjustment for quality of survival.

Study designs and other criteria for inclusion in the review

For surgical series the inclusion criteria were:

(1) more than 75% of patients also received fractionated radiotherapy;

(2) the study occurred in the computed tomography era;

(3) median survival and 30-day operative morbidity and mortality were reported;

(4) the data were not subsequently included as part of an updated series or review article;

and (5) tumor histologies were reported.

For stereotactic radiosurgery the inclusion criteria were the same with the addition that the technology used was the cobalt-60 gamma knife (Elektra Instruments, Atlanta, GA).

Sources searched to identify primary studies
The review of the medical literature searched MEDLINE from 1974 to 1994 and Cancerlit for 1983 to 1994.

Criteria used to ensure the validity of primary studies
Not stated.

Methods used to judge relevance and validity, and for extracting data
Not stated.

Number of primary studies included
Three surgical resection series met all criteria with a total of 182 patients. Only one radiosurgery study met all criteria: it represented a five-institution experience with 116 patients. Two of the surgical resection series were prospective, randomized trials.

Methods of combining primary studies
A narrative method was used to combine the studies. Survival data was based on case-weighted median survival for all patients (SUM [(no. patients in series)x(series median survival)]/total patients).

Investigation of differences between primary studies
Not stated.

Results of the review
The reported treatment morbidity and mortality were higher after surgical resection (29.7 and 6.6%, respectively) than after radiosurgery (4.3% morbidity and 0% mortality) although 10 patients who eventually required surgical resection despite radiosurgery were not included in the calculation of the reported treatment morbidity. If these 10 patients are added to the radiosurgery morbidity calculation, a rate of 12.9% is obtained. The case-weighted median survivals were 11.37 months after surgical resection and whole brain radiotherapy (WBR) and 11 months after radiosurgery and WBR.

Measure of benefits used in the economic analysis
The outcome measure used in the economic analysis was life years gained.

Direct costs
Costs were estimated to reflect the monetary value of the actual resources used for either surgical resection or stereotactic radiosurgery services. The mix of services provided and the resources used during typical treatment scenarios for each modality were modelled.

This included pre-procedure imaging and other diagnostic services, the surgical resection or radiosurgery services

patients received while hospitalized, and follow-up care. Physician costs were estimated using Medicare's national fee schedule, the resource-based relative value scale.

Hospital costs for microsurgery and for short stays associated with gamma knife radiosurgery were estimated using data from the 1992 Medicare Provider Analysis and Review file. The cost of a short hospital stay for radiosurgery (excluding the stereotactic radiosurgery procedure cost) was estimated by taking the national average charge for an overnight hospital stay and multiplying it by the average hospital cost-to-charge ratio.

The cost of an uncomplicated surgical resection stay was estimated as the product of the average hospital charge for a craniotomy and the average hospital cost-to-charge ratio. Stereotactic radiosurgery procedure costs were estimated through a detailed financial survey of sites that perform the procedure using a gamma knife.

Treatment morbidity costs were based upon specific complications reported in the studies selected for the analysis.

Discounting of costs were not performed for three reasons: (1) the vast majority of costs are immediately incurred; (2) even full discounting of costs incurred late in the survival period would have little impact on the overall cost totals; (3) it is impossible to know when various costs are incurred in the post-treatment intervals.

Currency
US dollars ($).

Sensitivity analysis
Threshold analyses, defined as the change required in each of 7 key variables, that would result in an equalization of the incremental cost-effectiveness of the two treatments, were performed.

Estimated benefits used in the economic analysis
The case-weighted median survivals were 11.37 months after surgical resection and whole brain radiotherapy (WBR) and 11 months after radiosurgery and WBR. Both survivals were substantially longer than for WBR alone (4.76 months).

Cost results
Radiosurgery had a lower cost per procedure ($22,743) than surgical resection ($30,461). This resulted both from a lower uncomplicated cost per procedure ($20,209 versus $27,587) and from a lower contribution from treatment morbidity: $2,534 (includes the craniotomy costs) versus $2,784 on a per-case basis.

Synthesis of costs and benefits
Radiosurgery was more cost-effective than surgical resection. Surgical resection resulted in a cost effectiveness of $32,149 per life year compared with $24,811 per life year for radiosurgery. When compared with fractionated radiotherapy as a baseline treatment, the incremental cost effectiveness of radiosurgery was superior to that of surgical resection. Surgical resection added life years, above those attributable to radiotherapy alone, at a cost of $52,384 per life year, whereas those added by surgery came at a cost of $40,648 per life year.

To create equal incremental cost effectiveness between surgical resection and radiosurgery, it would be necessary either to: (1) increase the surgical resection procedure cost by 34.7%; (2) decrease the average annual surgical resection procedure volume by 38.7%; (3) increase the surgical resection average morbidity cost by 240.5%; (4) reduce the median survival after surgical resection by 12.7%. Similarly, reducing the surgery procedure cost by 18.8% or increasing the median survival by 16.8% would be necessary to equal the incremental cost effectiveness of surgical resection.

Authors' conclusions

The authors concluded that radiosurgery had a lower total cost per procedure (by 25.8%) and was more cost effective (by 22.8%) than surgical resection of solitary brain metastasis. It is important to understand that the results of this economic analysis should be interpreted within the limitations of the methodology used. A multicentre, prospective, resource-based data collection study of surgical resection and radiosurgery might analyse the efficacy and cost-effectiveness of the current treatment options for solitary metastatic brain tumours.

CRD Commentary

As the authors noted, there was no well-matched cohort study available in the literature. This may have biased the analysis against the treatment that accepted the more severely ill patients. In addition, the studies used lacked detailed clinical follow-up about the duration of quality of life and the occurrence of both neurological and non-neurological morbidity. Finally, the studies provided no information regarding resource utilization by the treatment modalities or in the post-treatment survival period. Because of this a model approach had to be used.

Source of funding

Bibliographic details

Rutigliano M J, Lunsford L D, Kondziolka D, Strauss M J, Khanna V, Green M. The cost effectiveness of stereotactic radiosurgery versus surgical resection in the treatment of solitary metastatic brain tumors. Neurosurgery 1995; 37(3): 445-453

PubMedID

7501109

Indexing Status

Subject indexing assigned by NLM

MeSH

Brain Neoplasms /economics /mortality /secondary /surgery; Cost-Benefit Analysis; Craniotomy /economics; Humans; Postoperative Complications /economics /mortality /surgery; Prospective Studies; Quality-Adjusted Life Years; Radiosurgery /economics; Randomized Controlled Trials as Topic; Reoperation /economics; Survival Rate

AccessionNumber

21995001048

Date bibliographic record published

31/10/1997

Date abstract record published

31/10/1997