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Original Article

Quantifying Health Utilities in Patients Undergoing Stereotactic Body Radiation Treatment for Liver Metastases for Use in Future Economic Evaluations

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Abstract

Aim: Stereotactic body radiation therapy (SBRT) is increasingly used as an option for those with liver metastases. In order to facilitate future economic impact of health technologies, health utility scores may be used. The EuroQOL-5D-3L (EQ-5D) preference-based healthy utility instrument was used to evaluate the impact of treatment with SBRT on health utility scores.

Materials and methods: Between August 2013 and October 2014, 31 patients treated with 3–5 fractions of SBRT for liver metastases were enrolled in this study. The EQ-5D instrument was administered at baseline, during and up to 6 months post-SBRT.

Results: Mean EQ-5D score at baseline was 0.857, which remained stable across the entire study time period. Transient increases in difficulties with mobility (9.7% reported at baseline to 16.1% on the last day of treatment) and usual activities (3.2% reported at baseline to 34.5% on day two) were found during the course of treatment; these returned to baseline levels subsequently. The mean visual analogue score at baseline was 65.8 and remained unchanged throughout treatment and follow-up.

Conclusions: The stability of health utility scores and problems reported by patients undergoing treatment indicate that SBRT for liver metastases does not impart a significant adverse effect on quality of life. These results may be used for future economic evaluation of SBRT.

Keywords: Health utility score; liver metastases; quality of life; stereotactic body radiation treatment

Introduction

Metastatic spread to the liver is a common event in the progression of multiple tumours, most commonly in the case of colorectal, lung and breast primary origin. This event has a role in the mortality of many cancer patients, especially in the context of disease arising from the gastrointestinal tract. As the incidence of all cancer cases is expected to almost double by 2030 [1], several treatment modalities for liver metastases, including radiation treatment, need to be tested and optimised for future use [2].

Surgical resection is still considered the only treatment associated with long-term survival in patients with colorectal liver metastases [3], as well as liver metastases from

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other primary sites [4]. Unfortunately, as many as 80% of these patients will not be eligible for surgical resection [5]. Other options, such as radiofrequency ablation (RFA), cryotherapy, chemoembolisation and high-intensity focal ultrasound, can control disease [6]; however, outcomes remain poor in the long term.

Stereotactic body radiation treatment (SBRT) is a form of radiation treatment in which a high dose per fraction is delivered in a limited number of fractions, with the aid of image guidance and patient immobilisation devices to minimise the treatment set-up margins of the irradiated tumour [7]. With SBRT, there is a steep dose gradient outside the target volume to decrease the dose to the surrounding organs at risk and, hence, reduce the probability of normal tissue complications [8]. Recently, SBRT has emerged as an attractive non-invasive treatment alternative to surgical resection for liver metastases [9,10]. In colorectal liver metastases, SBRT can achieve 18 month local control rates of 84% when treated with doses $\geq$42 Gy [11]. However, there has not yet been a phase III evaluation of this technology [12]. Concern has already been voiced about the possible technology creep, should this not be adequately evaluated in a reasonable time frame [13].

One important consideration in the evaluation of health technologies is the concept of health utilities; these are preference-based scores that are rank ordered according to country-specific valuation studies. These values fall from less than 0 to 1. Any negative score is assessed as worse than dead, e.g. it is reasonable to foresee how a state of severe illness, where many comorbidities and symptoms are present, may be 'ranked' as worse than being dead; dead is represented as 0 and 1 is a mark of perfect health [14]. An instrument that is commonly used to measure health utilities is the EuroQol-5D (EQ-5D), which provides health utility index scores covering five dimensions of health [15]. The health utility scores may be used to determine quality-adjusted life years, which are used in economic evaluations of emerging technologies. Indeed, there is still a need to assess the health utility scores of those undergoing SBRT in order to evaluate this technology in terms of cost-effectiveness.

The objective of this study was to quantify health utility scores through the use of the EQ-5D in a cohort of patients undergoing SBRT for liver metastases for use in future economic evaluations of this technology.

Patients and Methods

Patient Population

Patients with liver metastases starting treatment with SBRT were eligible for this study. Patients eligible for SBRT had one to three liver metastases confirmed on imaging scans; at least 700 cm^3 of uninvolved liver; the maximum size of the target liver lesion was 6 cm or less; Child–Pugh's A liver score; Eastern Cooperative Oncology Group performance status < 2; estimated life expectancy more than 3 months. Those with extrahepatic disease were included if the maximum number of organs involved (including the liver) was three or less, otherwise defined as oligometastatic disease. Informed consent was obtained for every patient. Institutional research ethics board approval was obtained.

Radiation Treatment

The simulation process has been described previously [16]. Patients were immobilised supine in a customised body mould or in a thorax BlueBAG BodyFIX (Medical Intelligence, Schwabmuenchen, Germany) double-vacuum cushion. Liver breathing motion was reduced with an abdominal compression plate. Patients were simulated with timed intravenous contrast-enhanced (Medrad Stellant CT injection system, Indianola, Pennsylvania, USA) four-dimensional computed tomography scan (Brilliance CT Big Bore, Philips, Cleveland, Ohio, USA) to account for liver motion from respiratory breathing.

The gross tumour volume was contoured on the average, 0% and 50% images. An internal tumour volume (ITV) was generated by the summation of all the gross tumour volumes in all respiratory phases. A planning target volume was generated by an isotropic 5 mm expansion around the ITV.

Patients were treated with three to six fractions of SBRT using three to 10 coplanar and up to three non-coplanar beams; radiation fractions were delivered every other day for the course of the treatment. The prescription dose was determined by the volume of liver receiving less than 15 Gy and dose constraints to surrounding organs at risk. At least 99% of the prescribed dose was directed to the ITV and 95% of the planning target volume. Dose-limiting structures included: uninvolved liver, kidney, spinal cord, stomach, duodenum, bowel, heart and chest wall. Verification of positioning was carried out before each treatment delivery by acquiring a kV cone-beam computed tomography scan on the treatment unit. Repositioning was conducted for offsets in the liver position of more than 1 mm and 1 degree, using the liver as a surrogate for the tumour.

Health Utility Measurement

The EuroQOL-5D-3L (EQ-5D-3L) is a preference-based health utility instrument that explicitly explores five dimensions of health and includes a visual analogue scale (VAS) to survey generic health-related quality of life [15,17]. These dimensions are: mobility, self-care, usual activities, pain/discomfort and anxiety/depression. Each dimension has three possible levels of response: (i) no problems; (ii) some problems; (iii) major problems. The VAS is a health state scale with a thermometer-like appearance and the individual must mark their current health state at the moment the survey is given. The answers to the five dimensions are converted to an index score based on country-specific values. Herein we converted the scores into Canadian EQ-5D-3L scores based on the value set published for this country [18]. The range of possible Canadian EQ-5D-3L

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