

to severe co-morbidity. Stereotactic body radiotherapy (SBRT) has been used for treatment of patients with limited stage NSCLC who are unfit for surgery.

Methods and materials: Forty patients with stage I NSCLC were included into a phase II trial. The patients were immobilized by the Elekta stereotactic body frame (SBF) or a custom made body frame. SBRT was given on standard LINAC with standard multi-leaf collimator. Central dose was 15 Gy \times 3 within 5–8 days.

Results: Median follow-up time of the patients was 2.4 years. Eight (20%) patients obtained a complete response, 15 (38%) had a partial response and 12 (30%) had no change or could not be evaluated. Only 3 patients had a local recurrence and local control rate two years after SBRT was 85%. Two years after treatment, 54% were without local or distant progression and overall survival was 47%. Within 6 months after treatment, one or more grade 2 reactions such as chest pain, skin reaction, increased use of analgesics, dyspnoea and deterioration in WHO performance status to 2 or higher was observed in 48% of the patients. Sixty-two percent and 63% of the patients experienced transient or permanent deterioration in lung function (grade > 1) or performance status (WHO > 1) during follow-up.

Conclusions: SBRT in patients with limited stage NSCLC results in high probability of local control and promising survival rate. The toxicity after SBRT of lung tumours is moderate. However, deterioration in performance status and respiratory insufficiency are observed.

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POSTER

Patterns of failure: following intraoperative radiation therapy and stereotactic radiosurgery for glioblastoma multiforme on magnetic resonance appearance

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Purpose: The purpose of our study was to evaluate the Magnetic Resonance (MR) appearance of the patterns of failure following Intraoperative Radiation Therapy (IORT) and Stereotactic Radiosurgery (SRS) for Glioblastoma Multiforme (GBM).

Method/Materials: From January 1982 to June 2003, 137 GBM patients underwent radiotherapy. From January 1982 to August 2000, 53 patients were selected for IORT. Of those patients, 22 patients were excluded from the study because enhanced MR imaging examinations were not performed before or after IORT. The remaining 31 patients were included the study population. All 31 patients had undergone tumor debulking confirming the diagnosis of GBM and received conventional external beam radiotherapy (30–57 Gy, mean 53.4 Gy) excluding 3 patients. From September 2000 to June 2003, 25 consecutive patients underwent SRS. All patients underwent enhanced MR imaging examinations before and after SRS, and had undergone tumor debulking confirming the diagnosis of GBM and received conventional external beam radiotherapy (38.4–60 Gy, mean 44 Gy) excluding 2 patients. Finally, 31 patients of IORT and 25 patients of SRS formed the study population. The radiation field of IORT was determined to affect a level of 2–6 cm deeper than the tumor-resected surface. The energy of the beams ranged 7 to 22 MeV (mean 11 MeV) depending on the estimated tumor depth. Irradiation in IORT was 10–50 Gy (mean 26.7 Gy). SRS was performed using a 10-MV linear accelerator. The planning target volume was the gross tumor (enhanced area on MR imaging) with 2 mm margin. The central dose was 20–30 Gy (mean 26.4 Gy) and marginal dose was 15–25 Gy (mean 20.8 Gy). After IORT or SRS, follow up gadolinium-enhanced MR images were obtained every 1–3 months. Recurrent patterns were classified into six patterns on MR images (local area within edema [1: focal, 2: semicircle, 3: circle, 4: no continuity to initial tumor], distant area [5: without edema, 6: local area + without edema]). As to the direction of the recurrence, recurrent patterns were classified into two patterns on MR images (1: including the direction to the cerebral ventricle, 2: the other).

Results: The progression free period of IORT was 6.1 months and that of SRS was 7.1 months. The progression free period of gross tumor resection was significantly ($P < 0.05$) longer than that of subtotal resection and partial resection in IORT, and was significantly ($P < 0.05$) longer than that of partial resection in SRS. As to recurrent patterns of MR images, local area within edema pattern was significantly ($P < 0.05$) seen both in IORT (84%) and in SRS (76%) than distant area pattern. Of local area within edema pattern, circle pattern was more predominantly seen 10 patients (38%) in IORT and 10 patients (53%) in SRS. As to the direction of the recurrence, all patients were including the direction to the cerebral ventricle both IORT and SRS.

Conclusions: The recurrence pattern of failure seems similar to the recurrence pattern of the conventional radiation therapy on MR appearance. Irradiated field in IORT and SRS should be included the cerebral ventricle neighboring the GBM.

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POSTER

Fractionated stereotactic radiation therapy using cyberknife for primary liver cancer

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Purpose: There currently is not a standard treatment for inoperable small and advanced hepatoma. Conventional radiotherapy is playing the limited role of the application against hepatoma, which shows one of the cancers with high incidence in Korea. There is a few report to evaluate the response of the fractionated stereotactic radiotherapy (FSRT) or radiosurgery(FSRS) to primary hepatoma. The purpose of the study was taken the preliminary result on the clinical trial of primary hepatoma (small and advanced) by the CyberKnife, as a new FSRT (or Hypofractionated Radiosurgery)-system.

Materials and Methods: From March 2004 to March 2005, 114 patients were hospitalized in the CyberKnife Center of Catholic University Medical College, and treated with CyberKnife for extracranial tumors. Among them, 32 patients were diagnosed to primary hepatoma and then 33 lesions applied by the CyberKnife. There were 20 male and 12 female patients. They had the age of 47–78 year old (median: 57) and the tumor size of 5.4–156 cc (median 27.5 cc). The total doses administered were 30–39 Gy (median 36 Gy) to the 70–83% (median 75%) isodose curve for 3 fractions. To relieve gastrointestinal trouble after treatment, we used Bismark and Buscopan during cyberknife.

Results: Follow-up ranged from 1 month to 5 months with median of 3 months. After treating CyberKnife to 33 lesions of 32 patients with primary hepatoma, the response of the tumor was examined by abdominal CT: they are classified by ten complete regression (31.3%), 13 partial regression (40.6%), 6 minimal regression (18.7%), 3 progression disease (9.4%). The positive responses more than partial remission were 23 patients (71.9%) after the treatment. In advanced hepatoma with portal vein or inferior vena cava thrombosis, 2 patients of total nine patients showed complete regression (22.2%) and two patients minimal regression (22.2%). The level of serum alpha-fetoprotein (AFP) after the treatment as compared with pretreatment had been 55% (17/32) decreased. There was no severe treatment-related complication except dyspepsia (1), mild nausea (6), abdominal discomfort (3) and transient changes of hepatic function (6). Two patients were died during the follow up due to hepatic failure with sepsis and progression of pre-existing lung metastasis.

Conclusion: CyberKnife to the patients with primary hepatoma was potentially suggested to become the safe and more effective tool than the conventional radiotherapy even though there were relatively short duration of follow-up and small numbers to be tested. And We expect CyberKnife become a new effective method for the management of advanced hepatoma with portal vein tumor thromboses (PVTT), inoperable and ineffective to transarterial chemoembolization (TACE).

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POSTER

Experimental model of radiation sequelae induced with single stereotactic irradiation to normal rabbit lung. Computed tomographical analysis

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Background: Hypofractionated stereotactic irradiation (HSTI) to treat early non-small cell lung cancer in Japan may be a possible alternative to surgical treatment. To examine the sequelae of HSTI treatment, we tried to establish an HSTI technique by irradiating normal rabbit lung and examining the radiation sequelae using computed tomography (CT) images.

Material and methods: Guidelines of the Keio University School of Medicine for the care and use of laboratory animals were followed in all experiments, and the use of rabbits was approved. Seven Japanese White Rabbits were anesthetized and partial spherical volume of each left lung was stereotactically irradiated with 4 MV of X-ray energy with a narrow beam of size 11 mm \times 11 mm. Three non-coplanar arcs (couch rotation: 0 deg \pm 45 deg) were employed for arc rotation. Each gantry rotation arc was 160 deg. The dose monitor units of irradiation were calculated by the standard inverse square law algorithm using the Batho Power Law as an inhomogeneity correction on the radiotherapy planning system (Eclipse[®]). Total irradiated dose of each rabbit varied and was 21, 30, 39, 48, 60, 60 Gy, respectively. The doses of irradiation were estimated using two different dose calculation algorithms, Convolution and fast superposition. After the irradiation, each rabbit (while under general anesthesia) was scanned with a CT scanner approximately biweekly and the image data were collected as Digital Imaging and Communications in Medicine (DICOM) Standard files. All rabbits were examined for 24 weeks