brain metastases. The dose delivered was 23.1 Gy in 3 fractions over 3 to 8 days, calculated on the 70% isodose line.
Results: Median follow up was 9.7 months (2.2 to 36.0 months). Twenty four patients (42.8%) needed salvage treatment of whom 5 (20.8%) had another stereotactic radiotherapy and 19 (79.2%) had other modalities of salvage therapy, mainly whole brain irradiation. The survival rates at 6, 12 and 24 months were 88.8%, 78.1% and 69.1% respectively.
Conclusion: Survival results are encouraging. Rigorous selection of patients is needed when using robotic stereotactic radiotherapy alone for the treatment of oligométastases of the brain. Close follow up allows salvage therapy in such cases.

8728 POSTER

Role of Surgery and Postoperative Radiotherapy for Patients RPA I or II With 1 or 2 Brain Metastases

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Purpose: To evaluate the role of surgery and postoperative radiotherapy in the management of brain metastases (BM). A retrospective analysis for overall survival of a serie of 282 patients with recursive partitioning analysis (RPA) I or II with 1 to 2 resectable BM treated with different schedules in single institution.
Methods: Patients with median age 61.5 at diagnosis were treated either with surgical resection followed by whole brain radiotherapy (WBRT) or with WBRT alone in 94 (33.3%) and 188 cases (66.7%) respectively. Dose of irradiation varied from 30 to 40 Gy in fractions of 2 to 3 Gy. Eighty-five patients who underwent surgery and 125 who benefited from WBRT alone received a WBRT boost to the metastatic site (from 9 to 17.5 Gy in 2 to 3 Gy per fraction). Diagnosis has been established by contrast CT scan or MRI or both. BM were located in the cerebral hemispheres (76.6%), in the cerebellum (16.3%) or in these two sites (7.1%). Primary tumours were lung (61.4%), breast (11.4%), melanoma (6%), gastrointestinal (7.4%), kidney (4.6%) and other sites (9.2%). In the surgical group, patients were RPA I and II in 43 and 51 cases, respectively and had 1 or 2 BM in 86 and 8 cases, respectively. In the group of definitive WBRT, patients were RPA I and II in 19 and 169 cases, respectively and had 1 or 2 BM in 115 and 73 cases, respectively. Survival probabilities were calculated using the Kaplan–Meier method.
Results: Median overall survival was higher in RPA I group compared to RPA II group: 34.5 months ($n = 62$) and 8.6 months ($n = 220$), respectively ($p < 0.0001$). There was a significant improvement of overall survival in the surgical group compared to definitive WBRT group: 20.9 months vs 7.8 months ($p < 0.0001$), also 6-month and 1-year overall survival were significantly better: 87.5% vs 63.4% and 68.2% vs 32.8%, respectively. Patients who underwent a WBRT boost had an improved outcome but the difference was not statistically significant: 22 months vs 19.1 months for the surgical group and 8.7 months vs 6.6 months for the second group. In multivariate analysis, presence of extracranial metastases and control of primary tumour were significant prognostic factors for the two groups ($p = 0.002$ and $p = 0.008$ respectively for the surgical group; $p = 0.04$ and $p = 0.01$ respectively for the definitive WBRT group). In the definitive WBRT group type of primary tumour was also significant ($p = 0.0008$).
Conclusion: Surgical resection followed by WBRT lead to a better outcome compared to WBRT alone for patients with 1 or 2 BM, and for RPA I or II. An additional WBRT boost did not improve significantly the overall survival, whatever the treatment schedule.

8729 POSTER

Post-Operative Irradiation Volume and Survival of Patients With High-Grade Malignant Gliomas

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Background: According to recent recommendations, initial post-operative volume of irradiation (RT) in high-grade malignant gliomas (HGMG) has been shrunken from whole brain to tumour bed with margins. Probable sequences of that change are still unclear. We conducted retrospective trial to compare outcomes of the treatment focusing on mentioned radiation treatment characteristic.
Materials and Methods: Outcomes of HGMG patients treated with consecutive surgery, RT/chemoRT and chemotherapy were compared with reference to the volume of initial RT: whole (30 Gy/15 fr to whole brain than local irradiation with margin to edema to total 54−64/27−32 fr Gy, WBI) versus local (LBI). Proportions were assessed using chi-square. Overall survival (OS) was chosen as endpoint. Kaplan–Meier plots with log-rank test were used for comparisons. Univatiate and multivariate analyses were applied with proportional hazards Cox regression model.
Results: Total 427 patients with G3−4 gliomas were selected. Three hundred forty four (81%) were irradiated locally only, while 83 − with initial whole brain RT. Distribution according to basic initial characteristics between the two groups was similar except age >60 yrs (40% vs 25%, $p = 0.050$) and Karnovsky performance score less than 70% (53% vs 80%, $p = 0.035$) for LBI and WBI respectively. With median follow-up 2.6 (SD, 1.8) yrs of analysis 56 (16%) and 39 (47%) pts after LBI and WBI died. Median OS for LBI and WBI was 16 and 40 months respectively, log rank, $p < 0.0001$. Volume of irradiation significantly influenced on OS both in univariate, $HR = 2.1$, $p = 0.0005$ and in multivariate analysis, $HR = 1.6$, $p = 0.021$.
Conclusion: Avoiding whole brain irradiation in HGMG leads to significant gain of survival.

8730 POSTER

Stereotactic Radiosurgery and Radiotherapy in Benign Intracranial Meningioma

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Background: To investigate the role of stereotactic radio surgery (SRS) and hypofractionated stereotactic radiotherapy (SRT) in treatment of benign intracranial meningioma.
Materials and Methods: Between 2003–2010, 32 patients with a median age of 44 years (21−67 years) were treated with SRS ($n = 19$), and hypo fractionated SRT ($n = 13$) for intracranial meningioma. Of the 32 patients 14 underwent SRS or SRT as their primary treatment and 18 patients underwent post operative SRS or SRT (PORT). Progression free survival and overall survival, toxicity and symptomatology were evaluated.
Results: The median follow up was 39 months (6−72 months) and 5 year overall survival and Progression free survival were 90%±5 and 94%±4 after SRT/SRS respectively. The symptoms were improved or stable in 97% of patients. Acute toxicity was mild and seen in 41% of patients. Clinically significant late morbidity or new cranial nerve palsies did not occur.
Conclusion: Stereotactic radio surgery (SRS) and hypo fractionated stereotactic radiotherapy (SRT) are effective and safe treatment modality for local control of meningioma with low risk of significant late toxicity. In case of large tumour size and adjacent critical structures hypo fractionated SRT is highly recommended.

8731 POSTER

Cerebral Arteriovenous Malformations Treatment With Radiosurgery − Results From the CHUM

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Background: Therapeutic modalities for arteriovenous malformations (AVM) are embolization, surgery and radiosurgery, and they are usually used in association. Factors influencing the choice of therapy are mainly localization and size of the AVM, with the ones located in eloquent locations and of large size representing a significant surgical risk. Radiosurgery is recognized to offer a high obliteration rate for small and medium size lesions, with mild morbidity. We expose the characteristics of patients treated at the Notre-Dame hospital with radiosurgery, with special attention to obliteration rates and radionecrosis.
Materials and Methods: A systematic review of all cerebral AVM patients treated in the Radiation Oncology Department at the Centre Hospitalier de l'Université de Montréal, Notre-Dame hospital, from 1998 to 2008 inclusively was performed. A total of 43 patients treated with a single dose varying between 21 and 25 Gy were included. Medical files were analysed in order to assess the following informations: the characteristics of patients and AVM, the treatments received prior to radiosurgery, the date and the dose of treatment, the date of obliteration (absence of flow within the lesion demonstrated by digital angiography) and toxicities, when applicable. Revision of angiographies was performed to complete the data. Also, telephone interviews were done in order to evaluate the degree of limitation in daily life activities of patients.
Results: Most patients are men, with a mean age of 37 years old (12−65). Over 75% presented with haemorrhage, and two patients had a fortuitous diagnosis. AVM of 3 cm or more in diameter was found in 20.9% of patients.

Only three patients underwent surgery prior to radiosurgery, and the majority (73.2%) received one or many embolisations prior to radiosurgery. In patients followed with angiography for a minimum of three years, 93.8% (30/32) had complete obliteration, after a median of 24.2 months post treatment. Only one patient presented a non fatal haemorrhage between treatment and obliteration. The symptomatic radionecrosis rate is of 8.8%. The median modified Rankin score of our patients is 2, with the mode being 1. No patients defined their symptoms as severely disabling.
Conclusions: Our study shows both obliteration and complication rates in the upper limit of those reported in the literature. Radiosurgery thus seems a good treatment option for small AVM at our center. Furthermore, widespread use of embolization does not seem to affect obliteration rate outcome.

8732 POSTER

Extraventricular Neurocytoma − Clinical Features, Treatment Outcomes, and Prognostic Factors

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Purpose: To know clinical features, treatment outcomes, and prognostic factors of extraventricular neurocytoma (EVN), a new disease entity since 2007 by the WHO classification of tumours of the central nervous system.
Methods and Materials: Since 2007, thirteen patients were diagnosed as EVN at Seoul National University College of Medicine. There were 7 patients with atypical EVN, 6 patients with EVN. At the same period, there were 5 patients with central neurocytoma (CN), and no patients of atypical CN. Median age for all patients was 44 years old (range, 5−67), and 12 patients were male. In case of atypical EVN, 5 patients had subtotal resection, and 2 patients had gross total resection. Among 6 patients with EVN, 5 patients had gross total resection, 1 patient had only stereotactic biopsy. Three patients of CN had gross total resection, and 2 patients of CN had subtotal resection. All patients of atypical EVN and 1 patient of EVN had radiotherapy (median 57.6 Gy, range, 45–61.2). None of CN received radiotherapy. Only one patient with atypical EVN received concurrent temozolomide during adjuvant radiotherapy.
Results: Of atypical EVN, number of patients with complete response (CR), partial response (PR), and stable disease (SD) at 1 month after adjuvant RT completion was 1, 1, and 5 patients respectively. At 4 months after adjuvant RT, there were 1, 1, and 5 patients of CR, PR, and SD, respectively. Among 5 patients of response with SD, three patients experienced local recurrence at 6, 23, and 25 months after treatment completion. One patient experienced local recurrence with leptomeningeal seeding, and died due to progression of disease at 14 months after adjuvant RT. Other two patients received re-operation and gamma-knife radiosurgery, respectively. The median and 2-year progression-free survival of atypical EVN was 25.7 months, and 61%. None of patients with EVN experienced recurrence. Of CN, one patients experienced local recurrence at 16 months after initial surgery, and have gamma-knife radiosurgery. At present time, 2 patient of atypical EVN, 5 patient of EVN, and 2 patient of CN are alive without evidence of disease. Three patients of atypical EVN, 1 patient of EVN, and 3 patients of CN still have disease, although size of tumour was markedly decreased. One patient of atypical EVN, who had already gamma-knife radiosurgery to recurrent tumour, has ongoing chemotherapy due to progression of disease.
Conclusion: The local control rate of EVN with atypical feature was poor, even if adjuvant radiotherapy was given (although, no statistically proven). Compared with other previous studies of atypical CN, the local control rate of atypical EVN is also poor.

8733 POSTER

Gossypol Induces Apoptosis and Synergize With Radiotherapy and Temzolomide in Glioblastoma Cells

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The median survival of patients diagnosed with grade IV astrocytomas (glioblastoma multiforme or GBM) is less than a year whatever the conventional therapies chosen (surgery, radiotherapy [RT] and/or chemotherapy [CT]). Therefore, new alternatives are highly needed. Recent studies suggest that gossypol, a bioactive phytochemical produced by cotton plants, is a promising agent against solid tumours. The current studies were undertaken to examine the chemotherapeutic efficacy of gossypol on human GBM cell lines as well as the sensitizing effects of this drug versus RT and the alkylating agent, temozolomide.
Gossypol reduced viability of a set of seven GBM cell lines (U87MG, A172, U251, U138, U373, LN228 and T98G) with an IC_{50} between 3−5 μM. A reduction in cell number can either be the consequence of gross injury to the cells, cytotoxicity, or the consequence of an actively driven biochemical process such as cell cycle arrest or apoptosis. To ensure that the growth inhibitory effect of gossypol on GBM cells was not a consequence of cytotoxicity, LDH leakage in response to 1, 5, and 10 μM of gossypol was performed. As demonstrated gossypol exerted no cytotoxicity on GBM cells. Additionally, molecular and functional analyses suggested that the decrease in viability was associated with increased DNA damage and the induction of apoptosis. We demonstrated that exposure of GBM cells to gossypol (1−10 μM) reduced the expression and activity of proteins involved with ERK/MAPK signaling pathway, JAK/Stat signaling pathway, and cell structure whereas Gossypol activated proteins that are involved in the mitochondrial apoptotic pathway and increased the phosphorylation of p53 at serine-392, which is phosphorylated in response to DNA damage. The effects of gossypol were similar in GBM expressing or not cancer stem cell phenotype suggesting that this agent could inactivate survival pathways involved in the cancer stem cell mediated recurrence.
We observed also increased the efficacy of both RT with Combination indices (CI) ranged between 0.34 and 0.76. The effects of temozolomide were also amplified by gossypol treatment in MGMT negative GBM cell lines with CI ranged between 0.52 and 0.82 whereas these effects were additive (CI of 1.00) or only partially synergistic (CI=0.89–0.97) in MGMT positive GBM cell lines.
Collectively, this data supports the use of gossypol as a novel agent for GBM as ameliorative agents of RT and CT.

8734 POSTER

Treatment of Low Grade Glial Tumours With Robotic Stereotactic Radiosurgery

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Background: We retrospectively evaluated our robotic stereotactic radiosurgery (SRS) treatment results in patients with low grade glial tumours.
Material and Methods: Twenty-nine patients with the diagnosis of low grade glial tumour treated between June 2007 and September 2010 with robotic SRS were evaluated. The median age was 36 years old (range, 4−70) and 11 of them were female. Ten patients had prior radiotherapy (RT) history and the median delivered dose was 60 Gy (range, 54−60 Gy). The time interval between the first RT and the salvage SRS was median 28 months. SRS was delivered with CyberKnife® (Accuray Inc., Sunnyvale, CA). The median SRS dose was 25 Gy (15−35 Gy) and it was given in 1−6 fractions (median 5 fractions). Homogeneity and conformality index values were 1.27 and 1.58 respectively. The volume of the tumour treated was median 26 cc (range, 0.5–130 cc).
Results: Median follow up was 21 months (range, 3−40 months). Overall survival and loco-regional control (LRC) rates were 82.7%, 68%, respectively. Increase in total BED2 dose values resulted in higher LRC ($p = 0.047$). The treatment was generally well tolerated. We observed no serious late toxicity at the time of reporting.
Conclusion: Robotic SRS seems to be a valid option in the treatment of patients with low grade glial tumours with low toxicity rates.

8735 POSTER

Simultaneous In-field Boost for Patients With 1 to 4 Brain Metastases Treated With Volumetric Modulated Arc Therapy With or Without Surgery − a Prospective Study on Quality-of-life

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Background: To assess treatment toxicity and patients' survival /quality of life (QoL) after volumetric modulated arc therapy (VMAT) with simultaneous in-field boost (SIB) for cancer patients with 1−4 brain metastases (BM) treated with or without surgery.
Methods and Materials: Between March and December 2010, 29 BM patients (total volume BM, $<40\ cm^3$) aged <80 years, KPS $\geqslant$ 70, RPA <III were included in this prospective trial. Whole brain VMAT (30 Gy) and a SIB to the BM (40 Gy) was delivered in 10 fraction. Mean age was 62.1 ± 8.5 years. Fifteen (51.7%) underwent surgery. KPS and MMSE were prospectively assessed. A self-assessed questionnaire was used to assess the QoL (EORTC QLQ-C30 with -BN20 module).
Results: After a mean FU of 5.4 ± 2.8 months, 14 (48.3%) patients died. The 6-month overall survival was 55.1%. Alopecia was only observed in 9 (31%) patients. In 3-month survivors, KPS was significantly ($p = 0.01$) decreased. MMSE score remained however stable ($p = 0.33$). Overall, QoL did decrease after VMAT. The mean QLQ-C30 global health status ($p = 0.72$) and emotional functional ($p = 0.91$) scores were decreased (low QoL). Physical ($p = 0.05$) and role functioning score ($p = 0.01$) were significantly worse and rapidly decreased during treatment. The majority