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Original Article

The Outcome of Craniospinal Irradiation in Supine Position at Siriraj Hospital: Preliminary Results

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Abstract

Objective: To study the outcome of craniospinal irradiation (CSI) in supine position in aspect of treatment control and acute treatment toxicity.

Materials and Methods: The medical records of all patients treated with CSI in supine position between July 2007 and December 2008 at Division of Radiation Oncology, Department of Radiology, Siriraj Hospital were retrospectively reviewed.

Results: Twenty patients were identified with 13 (65%) showed complete response at median follow-up 23.5 months. No one developed intracranial, spinal or distant failure. No disease failure occurred at craniospina or spinalspinal junction from CSI in supine position. Grade 3-4 leucopenia and neutropenia were found in 13 (65%) and 11 (55%) patients respectively.

Conclusion: Supine position can be an alternative technique for CSI. Disease control is acceptable with some Grade 3-4 hematologic toxicity.

Keywords: Craniospinal irradiation, supine position

Introduction

The entire craniospinal axis is the standard volume for radiation therapy (RT) in tumors with risk of leptomeningeal involvement. These tumors are found in pediatric patients who require anesthesia during treatment. Craniospinal irradiation (CSI) need to encompass whole brain and whole length of spinal axis with covering meninges. This technique has traditionally been administered to patients in prone position using lateral opposed cranial fields and posterior spinal fields down to the end of thecal sac. This position allows direct visualization of junction for craniospinal field and spinalspinal fields. Disadvantages of prone position are patient uncomfort, difficulty to tolerate especially in children and risk to access airway for anesthesia.

To minimize these disadvantages, CSI in supine position should be an alternative technique. This study reported our preliminary outcome with this technique in aspect of disease control and acute treatment toxicity.

Materials and Methods

The medical records of all patients treated with CSI in supine position between July 2007 and December 2008 at Division of Radiation Oncology, Department of Radiology, Siriraj Hospital were retrospectively reviewed. This study was approved by Siriraj Ethical Committee (Si202/2010)

Radiation Therapy

For simulation, all patients were in supine position with neck extended to avoid radiation to mandible. Patients were immobilized by customized thermoplastic mask for head and styrofoam pad for trunk. Axial computed tomography images were obtained with a 5-mm slice thickness for entire craniospinal axis by Philips CT simulator. All data then were tranfered to treatment planning system (Eclipe version 8.1, Varian Medical Systems, Palo Alto, CA) for 3 -dimensional technique using lateral opposed cranial fields and posterior spinal fileds. Half beam block technique of cranial field with isocenter setting on midline and midplane at level of C3-C5 based on anatomy of patients were introduced. Collimators of cranial fields were rotated until completely matched with the divergence of posterior spinal field. For patients with spinal length more than 40 cm, the spinal field was split into 2 fields using 2 isocenters technique. The upper field still was asymmetric field with isocenter at 20 cm fixed distance from isocenter of cranial field. For the lower field, moving gap junction technique using asymmetric field was proposed to reduce overdose at field junction. Location of lower isocenter was determined at 10-15 cm from upper isocenter for the acceptable dose distribution at gap junction.The gap junction were moved 4 times at every 3 cm during whole course of RT as shown in Figure 1.

Chemotherapy

All patients with medulloblastoma received CSI followed by chemotherapy. Only weekly vincristine was given concurrent with RT. For patients with intracranial germ cell tumor and acute leukemia, chemotherapy was given before CSI.

Treatment response and toxicity

Treatment response were evaluated as complete remission (CR) or partial remission (PR) at 1 month after complete CSI. Acute treatment-related toxicity were evaluated according to Common Toxicity Criteria Adverse Event V.3.0 during CSI to 1 month after complete CSI. The guidelines

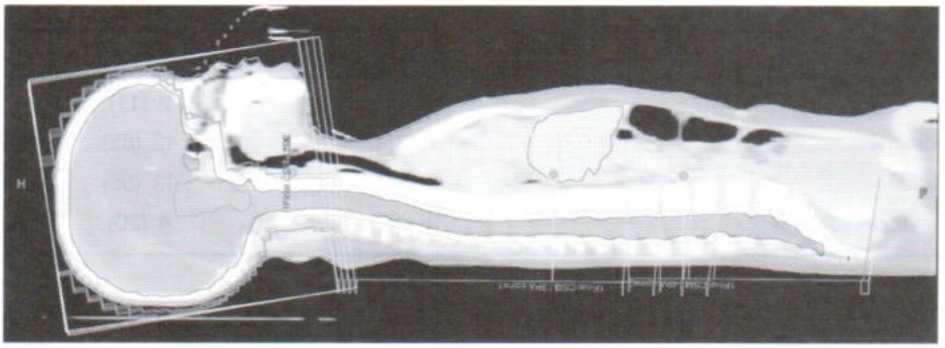

Fig.1 Mid-saggittal plane of patient treated with CSI in supine position. The gap junction were moved 4 times at every 3 cm during RT.

for interruption of RT were absolute neutrophil count <1.0x10 /L or platelet count <50x10/L.

Results

Total of 20 patients were identified in this study. Patient characteristics were shown in Table 1.

At a median follow-up 23.5 (range 3-35) months, 13 (65%) patients with CR and 7 (35%) patients with PR were documented respectively. Neither intracranial nor spinal failure developed in any patient. No distant failure was found. One patient with acute lymphoblastic leukemia and one patient with mixed germ cell tumor died from septicemia at 2 and 8 months after complete CSI respectively.

The pattern of acute hematologic toxicity were shown in Table 2.

Treatment interruption due to hematologic toxicity during CSI lasting 1-3 days were developed in 3 patients. Two patients were interrupted for more than 3 days. Skin toxicity showed no Grade 3-4.

Discussion

CSI in supine position have been investigated in many institutions due to practical advantages over

Table 1 Patient characteristics

Characteristics		No. of patients
Median age (year)		10 (range 2-46)
Gender	- Male	12
	- Female	8
Histology	- Medulloblastoma	9
	- Intracranial germ cell tumor	4
	- Acute leukemia	7
Median dose for CSI (Gy)		36 (range 21.6-39.6)
Median dose for primary tumor (Gy)	- Medulloblastoma	55.8
	- Intracranial germ cell tumor	54

Table 2 Acute hematologic toxicity

Toxicity	Gr1-2 (%)	Gr3-4 (%)
Anemia	18 (89)	2 (11)
Leucopenia	7 (35)	13 (65)
Neutropenia	9 (45)	11 (55)
Thrombocytopenia	16 (80)	4 (20)

traditional prone position[1-4]. Thses included patient comfort,high reproducibility and low risk for anesthesia. Matching technique for craniospinal and spinal spinal junction in CSI is important part of this complicated RT technique to prevent under or overdosage.Collimator rotation of lateral opposed cranial fields to match the divergence of posterior spinal fields is commonly used method. However, supine position does not permit direct observation for craniospinal and spinal spinal junctions so CT-based technique has to be used. With a median follow-up 23.5 months, no disease failure occurred at craniospinal or spinal spinal junctions from CSI in this study.

Some lliterature using supine position for CSI have been published. Huang et al reported on 14 medulloblastoma patients using CT-based technique. Two patients recurred in brain but no one recurred at craniospinal or spinal spinal junctions with median follow-up 32.4 months.Lymphopenia grade 3-4 was found in all[5]. South et al reported on 23 patients receiving supine CSI using intrafractional junction shift and field in field dose shaping.With median follow-up time 20.2 months, 5 failures occurred but not in junctions[6]. Alternative delivery methods for CSI have been used such as helical tomotherapy or proton-based technique[7-9].

Acute hematologic toxicity in this study were higher than those from CSI in prone position.Chang et al showed 32, 22 and 4 % leucopenia,neutropenia and thrombocytopenia respectively from mean dose photon 32 Gy for CSI in pediatric patients.[10]

Longer follow -up is needed for late treatment-related toxicity .Spinal intensity modulated RT have been investigated to improve target homogeneity by Panandiker et al. No neurotoxicity attributable to matching of craniospinal or spinalspinal junctions occurred.[11]

Conclusion

CSI in supine position is an alternative technique for RT in tumor with risk of leptomeningeal involvement. No disease failure occurred at craniospinal and spinal spinal junctions in this study but some Grade 3-4 hematologic toxicity were found.

References

1. Parker WA, Freeman CR. A simple technique for craniospinal radiotherapy in the supine position. Radiother Oncol. 2006 Feb;78(2):217-22.
2. Chang EL, Wong PF, Forster K, Petru A, Kowalski A, Maor M. Verification techniques and dose distribution for computed tomographci planned supine craniospinal radiaiton therapy.Med Dosimetry 2003,28,127-31.

3. Rades D,Baumann R,bremer M,Leuwer M,KarstenJ. Application of a new verification technique allowing craniospinal irradiation in supine position. Rad Oncol 2001;2:215-7.
4. Bauman G, Wong E, Trenka K, Scott D.A simple technique for craniospinal radiotherapy in the supine position Radiother Oncol. 2006 Sep;80(3):394. Epub 2006
5. Huang F, Parker W, Freeman CR. Feasibility and early outcomes of supine-position craniospinal irradiationPediatr Blood Cancer. 2010;54(2):322-5.
6. South M, Chiu JK, Teh BS, Bloch C, Schroeder TM, Paulino AC. Supine craniospinal irradiation using intrafractional junction shifts and field-in-field dose shaping: early experience at Methodist HospitalInt J Radiat Oncol Biol Phys. 2008;71(2):477-83.
7. Parker W, Brodeur M, Roberge D, Freeman C. Standard and nonstandard craniospinal radiotherapy using helical TomoTherapy.Int J Radiat Oncol Biol Phys. 2010;77(3): 926-31.
8. Sharma DS, Gupta T, Jalali R, Master Z, Phurailatpam RD, Sarin R.High-precision radiotherapy for craniospinal irradiation: evaluation of three-dimensional conformal radiotherapy, intensity-modulated radiation therapy and helical tomotherapy. Br J Radiol. 2009;82(984):1000-9.
9. Peñagarícano J, Moros E, Corry P, Saylors R, Ratanatharathorn V. Pediatric craniospinal axis irradiation with helical tomotherapy: patient outcome and lack of acute pulmonary toxicity. Int J Radiat Oncol Biol Phys. 2009; 75(4):1155-61.
10. Chang EL, Allen P, Wu C, Ater J, Kuttesch J, Maor MH. Acute toxicity and treatment interruption related to electron and photon craniospinal irradiation in pediatric patients treated at the University of Texas M. D. Anderson Cancer Center.Int J Radiat Oncol Biol Phys. 2002;52(4):1008-16.
11. Pai Panandiker A, Ning H, Likhacheva A, Ullman K, Arora B, Ondos J, Craniospinal irradiation with spinal IMRT to improve target homogeneity. Int J Radiat Oncol Biol Phys. 2007;68(5):1402-9.