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Preliminary Clinical Application of Fractionated Stereotactic Radiotherapy for Patients with Medium-Sized Brain Oligometastases

Ronghui Jin*

Department of Radiation, Shaanxi Provincial People's Hospital, Xi'an, Shaanxi Province, 710068, China

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Abstract: Objective: To analyze the effect of fractionated stereotactic radiotherapy for patients with medium-sized brain oligometastases. Methods: 68 patients with medium-sized brain oligometastases who received radiotherapy in the hospital from February 2021 to February 2022 were randomly selected for this study. A total of 34 patients in the control group were treated with conventional radiotherapy, and other patients in the observation group were treated with fractionated stereotactic radiotherapy. And the short-term curative efficacy, local control rate and complication rate were compared between the two groups. Results: The treatment effect of the observation group was better than that of the control group at 3 months, 6 months and 12 months after radiotherapy, and the incidence of complication rates was low in the control group ($p<0.05$). Conclusion: Fractionated stereotactic radiotherapy for patients with medium-sized brain oligometastases can effectively improve the treatment efficiency of patients and reduce complications, as well as having higher safety.

1. Introduction

Clinically, 1/3 of patients with malignant solid tumors will have brain metastases during the course of the disease. In addition to a small number of brain metastases that can be treated by surgery, most patients need to be treated by radiotherapy. Whole brain radiotherapy and local radiotherapy are common radiotherapy methods in the clinic, but whole brain radiotherapy has a large adverse effect on patients, resulting in a reduction in the quality of life of patients. Thus local radiotherapy is generally recommended in clinical practice. And the main method of local radiotherapy is fractionated stereotactic radiotherapy [1]. In order to further improve the cognition of fractionated stereotactic radiotherapy, this paper mainly analyzes its effect on the patients with medium-sized brain oligometastases.

2. Information and Methods

2.1 General Information

68 patients with with medium-sized brain oligometastases who received radiotherapy in the

hospital from February 2021 to February 2022 were randomly selected by computer for retrospective analysis. A total of 34 patients in the control group were treated with conventional radiotherapy. The patients were 19 males and 15 females, and their mean age was (53.34 ± 5.78) years. And other patients in the observation group were treated with fractionated stereotactic radiotherapy. The patients were 20 males and 14 females, and their mean age was (52.65 ± 5.43) years.

Inclusion criteria: (1) All patients were clinically diagnosed as brain oligometastases. There were 1 ~ 3 metastatic lesions confirmed by enhanced MR scanning, and the diameter of brain metastatic lesions was less than 4.0cm; (2) The patients and their families knew the contents of this study and signed the informed consent; (3) This study was discussed and approved by the Ethics Committee of the hospital.

Exclusion criteria: (1) Incomplete data; (2) Patients with other tumor diseases; (3) Those who have received brain radiotherapy.

2.2 Methods

The control group were treated with conventional radiotherapy, and the observation group were treated with fractionated stereotactic radiotherapy. During the treatment, the patient was kept in a supine position, and the head was fixed with a stereotactic hood. Patient's head was scanned with a Philips large-aperture CT scanner, and the thickness of the layer was set to 2 mm. Scanning was performed sequentially from the top of the skull to the base of the skull. The patient underwent enhanced MR scan of the brain, and the thickness of the layer was set to 2 mm. The tumor volume range of the patient was delineated according to the image information of CT and MR, and the radiation dose was calculated according to the patient's lesion. All treatment plans were carried out on the Varian TrueBeam (TM) linear accelerator, and the 6MV X-ray volumetric intensity modulated technology was used for the treatment. The patients were irradiated every other day, and the treatment cycle was one week.

2.3 Observation Indicators

The short-term curative efficacy, local control rate and complication rate were compared between the two groups. Among them, the curative efficacy mainly includes complete remission (the lesion disappears completely and the head symptoms disappear), partial remission (the product of two diameters of the lesions is reduced by more than 50%, and the head symptoms are obviously relieved), and stable (the product of two diameters of the lesions is reduced by 50%, and the head symptoms are relieved), progression (the product of two diameters of the lesions increases by 25%, and the head symptoms are aggravated) [2]. Treatment efficiency = (complete remission + partial remission + stable)/34 cases*100%. And complications mainly include headache, nausea, and limb movement disorders caused by radiation cerebral necrosis and level 2 acute radioactive central system.

2.4 Statistical Methods

The data were analyzed by SPSS 17.0 and measured by %. And the groups were compared by X^2, if $P<0.05$, there was significant difference.

3. Results

3.1 Comparison of Curative Efficacy and Local Control Rate of Patients

In this study, the symptoms of the patients in the observation group and the control group were relieved after the treatment. After 3 months of the treatment, the curative efficacy of the observation group was 97.06% (33/34) and that of the control group was 88.24% (30/34). After 6 months of the treatment, the curative efficacy of the observation group was 94.12% (32/34), and that of the control group was 85.29% (29/34). After 12 months of the treatment, the curative efficacy of the observation group was 85.29% (29/34) and that of the control group was 70.59% (20/34). All the above data indicate that there is statistical significance (P<0.05). The specific data are shown in Table 1.

Table 1: Comparison of curative efficacy and local control rate of patients (%(n) n=34)

Group	Curative efficacy	Observation group	Control group	X^2	p
3 months of the treatment	Complete remission	29.41%(10/34)	14.71%(5/34)	10.212	0.001
	Partial remission	35.29%(12/34)	23.53%(8/34)	10.165	0.001
	Stable	32.35%(11/34)	50.00%(17/34)	10.323	0.001
	Progression	2.94%(1/34)	11.76%(4/34)	10.316	0.001
	Curative efficacy	97.06%(33/34)	88.24%(30/34)	10.334	0.001
6 months of the treatment	Complete remission	26.74%(9/34)	11.76%(4/34)	10.287	0.001
	Partial remission	32.35%(11/34)	17.65%(6/34)	10.387	0.001
	Stable	35.29%(12/34)	55.88%(19/34)	10.176	0.001
	Progression	5.88%(2/34)	17.65%(6/34)	10.287	0.001
	Curative efficacy	94.12%(32/34)	85.29%(29/34)	10.325	0.001
12 months of the treatment	Complete remission	23.53%(8/34)	11.76%(4/34)	10.187	0.001
	Partial remission	52.94%(18/34)	11.76%(4/34)	10.329	0.001
	Stable	38.24%(13/34)	47.06%(16/34)	10.642	0.001
	Progression	14.71%(5/34)	29.41%(10/34)	10.398	0.001
	Curative efficacy	85.29%(29/34)	70.59%(24/34)	10.549	0.001

3.2 Comparison of Complication Rates between Two Groups

In this study, the complication rates in the observation group was 8.82% (3/34), and that in the control group was 29.41% (10/34). Specific data are shown in Table 2.

Table 2: Comparison of complication rates between two groups(%(n) n=34)

Group	Radiation cerebral necrosis	Level 2 acute radioactive central system			Complication rates
		Headache	Nausea	Limb movement disorders	
Observation group	0.00%(0/34)	2.94%(1/34)	2.94%(1/34)	2.94%(1/34)	8.82%(3/34)
Control group	5.88%(2/34)	5.88%(2/34)	8.82%(3/34)	8.82%(3/34)	29.41%(10/34)
X^2	10.154	10.165	10.321	10.319	10.463
p	0.001	0.001	0.001	0.001	0.001

4. Discussion

Medium-sized brain oligometastases mainly refers to the expansion and metastasis of tumor cells outside the central nervous system of patients to the brain tissue of patients, which belongs to a common malignant tumor disease. When brain metastases occurs in clinical treatment, it indicates that the patient's condition changes to a certain extent and the patient may danger to life. Therefore, special attention should be paid to brain metastases in clinical practice. With the continuous improvement of clinical medical technology, targeted therapy and radiotherapy have been continuously developed and optimized. For patients with brain metastases, the use of targeted therapy and radiotherapy can effectively prolong their life and improve the quality of their life. Among them, the effect of fractionated stereotactic radiotherapy can effectively control the condition of patients with brain oligometastases.

Due to the low a/β ratio of brain tissue in patients with brain oligometastases, fractionated stereotactic radiotherapy can effectively protect the normal brain tissue of patients. At the same time, in the course of fractionated treatment, it can effectively promote the reoxygenation efficiency of patients' hypoxic cells, improve the ability of cell cycle redistribution, and increase the sensitivity of cells to radiation. In the clinical treatment process, fractionated stereotactic radiotherapy achieves good therapeutic effect. First of all, it can position brain metastases precisely. Fractional stereotactic radiotherapy is an accurate stereotactic method, which can accurately locate the patients' medium-sized brain oligometastatic tumors. In addition, the therapeutic effect of multi-path irradiation is significantly better than that of conventional radiotherapy [3-4]. Moreover, from the perspective of clinical radiation dosimetry, when fractionated stereotactic radiotherapy is used, accurate dose radiation can be given to the tumor tissue of the patient. It has a greater killing effect on the tumor tissue, and reduces the radiation to the surrounding normal tissue. However, it is still harmful and will cause some adverse reactions to patients in the course of treatment. Common adverse reactions include radioactive brain necrosis, headache, nausea, and body movement disorder. In this study, the use of fractionated stereotactic radiotherapy can effectively improve the curative efficacy and local control rate of patients. And the local control rates of patients after fractionated stereotactic radiotherapy at 3 months, 6 months, and 12 months were better than that of conventional radiotherapy, and the adverse reactions during the treatment are low, and there is no radioactive brain necrosis. It can effectively reduce the probability of complications in level 2 acute radioactive central system [5-6].

In conclusion, the effect of fractionated stereotactic radiotherapy for patients with medium-sized brain oligometastases is significantly better than that of conventional radiotherapy, which can effectively improve the treatment efficiency and safety. Therefore, the radiotherapy method can be promoted and applied in clinical practice.

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