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Original Article

Study on the clinical application value of CT-guided 125I radioactive seed implantation in the treatment of spinal malignant tumor

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Abstract: Objective: To investigate the clinical application value of CT-guided 125I radioactive seed implantation in the treatment of spinal malignant tumor. Methods: A total of 48 patients with spinal malignant tumor admitted in our hospital from July 2015 to May 2016 were selected for this study, and these patients were then divided into experimental group (n=24) and control group (n=24). The patients in experimental group underwent CT to scan the spinal tumor geometry and then the method of guided 125I radioactive seed implantation was applied for the treatment of spinal malignant tumor; the amount and distribution of the radioactive seed were calculated by using the Treatment Planning System (TPS), and the surgical site-specific implantation was done by the image-guided puncture needle under direct vision according to the plan. Meanwhile, patients in control group underwent the traditional resection for treatment. And all the operations were completed successfully. Results: Follow-up visits were taken for both groups. In experimental group which patients underwent CT-guided 125I radioactive seed implantation to treat the spinal malignant tumor, the total effective rate was 79.1%, while that in the control group was 45.8%. The difference between the two groups was statistically significant (P<0.05). Besides, the Self-rating Depression Scale (SDS) score, Pittsburgh Sleep Quality Index (PSQI) score and National Institute of Health Stroke Scale (NIHSS) score in the experimental group were significantly lower than those in the control group, and the difference was statistically significant (P<0.05). Conclusion: 125I seed intratumoral radiation therapy can effectively treat the spinal malignant tumor, relieve the cancer pain, thereby improving the patients' life quality.

Keywords: 125I radioactive seed, CT guidance, spinal tumor

Introduction

Vertebral body is the most common occurring site of malignant spinal tumors [1, 2]. The most common symptom of spinal malignant tumors is pain, and the patients' clinical manifestations mainly include the local pain caused by the tumor-induced bone destruction, the progressive low back pain and the secondary symptoms induced by injuries of corresponding segmental spinal cord and nerve root. Patients with severe conditions may also have symptoms like vertebral body anomalies and compression of spinal cord and nerve root. Moreover, we may even find complications such as paralysis, spinal instability and so on, which can seriously affect the patient's life and quality of life, and threaten their life safety [3, 4]. There are a lot of limitations in the surgical tumor resection and the commonly used radiotherapy and chemotherapy. Radiotherapy and chemotherapy have poor therapeutic effects; surgical treatment may result in large trauma and many postoperative complications. With large incision, open surgeries are easy to damage the blood vessels and nerves and can also cause complications such as infection. And the postoperative recovery time is long [5]. Therefore, it is particularly vital to find a safer and more effective method of minimally invasive treatment. In recent years, as a new type of minimally invasive targeted therapy for malignant tumor, 125I radioactive seed interstitial implantation is helpful to inhibit the prolifera-

tion of tumor cells [6-10], so it has been gradually adopted and also have achieved positive therapeutic effects [11, 12]. In the study, 48 tumor patients underwent CT-guided 125I radioactive seed implantation for the treatment of spinal tumor metastasis and achieved favorable therapeutic results. And the report is as follows.

Materials and methods

General information

A total of 48 cases were selected from spinal malignant tumor patients admitted in our hospital from July 2015 to May 2016, and were then equally divided into experimental group and control group according to random number table. In the experimental group, there were 16 males and 8 females (48 to 80 years old) with an average age of 58.6±5.2 years old and the lesion amount of 39.4±1.4; in the control group, there were 15 males and 9 females (52 to 80 years old) with an average age of 56.0±4.9 years old and the lesion amount of 33.6±1.5. The comparison about general data of patients in the two groups revealed no statistically significant difference (P>0.05), which suggested that these data were comparable. The medical records of patients were checked, their relevant documents including operation agreements and consents of permanent implantation of human material were perfected before the operation, patients and their families were informed about the purpose of this study and then were required to sign the informed consent. Moreover, this study was approved by the Ethics Committee of our hospital. And the MRI, CT, ECT bone scan were conducted before the operation to determine the metastasis range, lesion and so on, so as to provide basis for surgical treatment.

Methods

Experimental group: Before the operation, examinations as about blood routine, biochemistry, blood coagulation function and tumor marker were performed in patients, and the tumor size and its diffusion range were then confirmed. Inside the 125I radioactive seed (4.5 mm in length and 0.8 mm in diameter) was silver rob which can absorb the 125I, while outside was the metal titanium package. The seed had a half-life of 59 d, an activity of 23.2-25.9 MBq, a half value lyer of 0.025 mm and a penetration radius of 1.7 cm. Moreover, the seed can also emit the low energy radiation persistently. The patients were placed in a prone position, draped after disinfection in the conventional manner, and then were given local anesthesia. After that, the puncture site and angle were determined under the CT guidance. The 125I seeds were implanted into the target areas via 18G puncture needles, and the distribution should be presented as fan shape as far as possible with 0.5 cm space between each seed. After the implantation of 8 to 15 seeds, the enhanced CT reexamination was performed immediately and the distribution of seeds was observed. If the aggregation and metabolism reduction occurred to the seeds, the seed replanting could be applied during the week after operation.

Control group: The conventional surgical tumor resection was performed in patients for their treatment. After operation, patients were required to maintain bed rest strictly, and their physiological indexes should be monitored carefully to prevent pulmonary embolism (PE) and other serious complications.

Observation indexes

Observation about treatment outcome of spinal malignant tumor with CT-guided 125I radioactive seed implantation: The postoperative follow-up was taken for 6 months among all the patients. And they were also required to perform CT reexamination every two months to analyze the local control rate and record the pain relief conditions. In accordance with the WHO curative effect evaluation of solid tumor, the criteria were as follows:

Complete Response (CR): all target tumor lesions disappeared and the pathological lymph nodes were found to have diameters of less than 10 mm. Partial Response (PR): a 30% decrease in the sum of diameters of target lesions when compared with the baseline sum diameters. Progressive Disease (PD): the absolute value of the sum of primary target lesion diameters increased by more than 20% and increased for 5 mm. Stable Disease (SD): the sum of baseline lesion diameters was decreased to some extent but had not reached PR or made increase, and also did not reach PD. RR was equal to CR plus PR.

Table 1. Comparison of general data between the two groups ($\bar{x}$±s)

Group	The number of cases	Male	Female	Age ($\bar{x}$±s)	The number of nidues ($\bar{x}$±s)
Experimental group	24	16	8	58.6±5.2	39.4±1.4
Control group	24	15	9	56.0±4.9	33.6±1.5
t				1.74	1.31
p				0.078	0.19

Table 2. Comparison of total effective rate between the two groups (n=48)

Group	Cases	CR	PR	NR	PD	Total effective rate (CR+PR)
Experimental group	24	11	8	3	2	79.1%
Control group	24	6	5	10	3	45.8%
X^2		2.513	2.314	2.418	2.531	2.128
p		0.0197	0.0218	0.0201	0.179	0.0344

Record of the pain relief conditions inpatients: The curative effect evaluation of pain was in accordance with the WHO criteria, and the pain score was graded as follows: grade III (severe pain), grade II (moderate pain), grade I (mild pain) and grade 0 (no pain). If the verbal Rating Scale (VRS) was decreased by 1 to 3 degree, it was regarded as pain relief [13, 14].

Curative effect evaluation of analgesia: complete remission (CR) meant the pain was completely relieved after treatment; partial remission (PR) indicated that pain was still existed after the treatment but reduced in comparison with that before the treatment, and did not affect the patients' normal lives; mild remission (MR) showed that patients still felt painful and their normal lives were disrupted although the pain was released as compared with that before the treatment; and no curative effect (NR) meant the pain was not relieved after the treatment when compared with that before the treatment.

Record of postoperative Self-rating Depression Scale (SDS) and Pittsburgh Sleep Quality Index (PSQI) scores: SDS was drawn up by Zung in 1965, which can reflect the subjective feeling of patients with depression. The testing objects are required to fill out the scale according to their actual situations in the recent one week. The scale has 20 items, which can also be divided into positive score items and reverse score items, and the 4-grade scoring system is applied. The standard total score (standard total score = total raw score *1.25, and then take the integer portion) is used as evaluation index. The standard total score <50 is regarded as normal while standard total score ≥50 indicates that the patients have symptom of depression. PSQI is composed of 19 self-assessment questions and 5 evaluation questions from sleeping companions. Only the scores of 19 self-assessment questions are included and the questions consist of 7 factors scoring from 0 to 3 points. Zero point means there is no difficulty while three points means great difficulty. The sum of 7 factors' scores serves as the total scale score (ranging from 0 to 21), and the sleep quality is divided into three grades according to PSQI total score as follows: good (PSQI≤4), fair (4<PSQI<7) and poor (PSQI≥8). Within 24 h after operation, the SDS and PSQI scores were conducted among patients in the two groups in line with the above criteria and the score were then recorded.

Record of post-operative National Institute of Health Stroke Scale (NIHSS) score: The NIHSS is a standard examination in the department of neurology, which is used for the description of neurological impairment in a large number of stroke patients enrolled in the experimental treatment. The consciousness, gaze, vision, peripheral facial paralysis, movement of upper limbs, ataxia of extremities, sensation and language in patients were scored respectively and the patients' neurological impairment were also observed. During the 24 hours and 14 days after operation, the patients' scores of NIHSS in the two groups were recorded respectively.

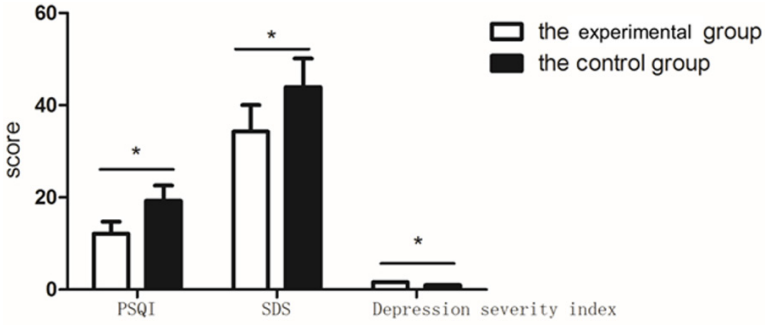

Figure 1. Comparison of SDS and PSQI scores between the two groups.

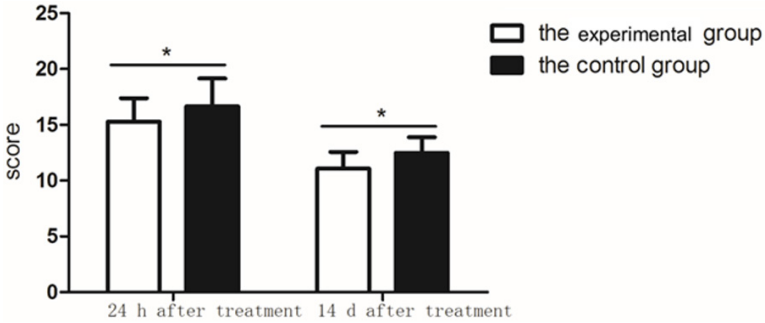

Figure 2. Comparison of NIHSS scores between the two groups.

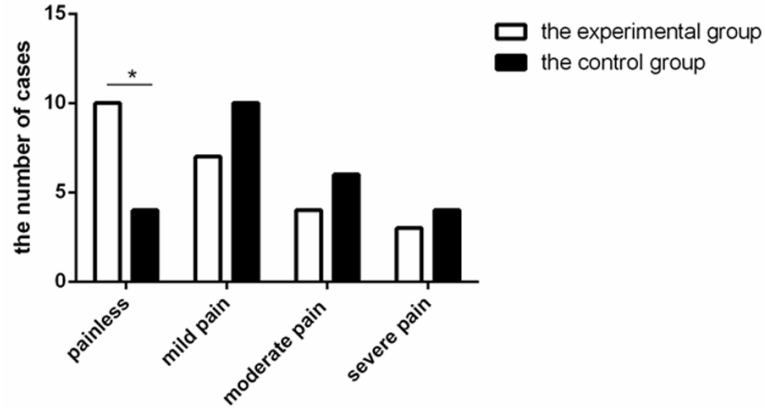

Figure 3. The number of patients with pain relief.

Statistical methods

The data were statistically analyzed by using the SPSS20.0 statistical software. The measurement data were expressed as mean and standard deviation ($\bar{x}\pm s$), and the comparison about general data of patients in the two groups was performed by using the t test. The numeration data were expressed as percentage, and the chi-square test was applied for analysis. $P<0.05$ was considered to indicate a statistically significant difference.

Results

Comparison of general data between the two groups

The general data of patients in the two groups were compared and the difference was not statistically significant ($P>0.05$), which suggested that these general data were comparable. As shown in **Table 1**.

Comparison of total effective rate between the two groups

The clinical treatments were performed in the two groups. And six months later, the total effective rate in experimental group was significantly higher than that in control group, and the difference was statistically significant ($P<0.05$). As shown in **Table 2**.

Comparison of SDS and PSQI scores between the two groups

After the treatment, the SDS and PSQI scores in experimental group were lower than those in control group, and the difference was statistically significant ($P<0.01$). As shown in **Figure 1**.

Comparison of NIHSS scores between the two groups

After the treatment, the NIHSS score in experimental group was lower than that in control group, and the difference was statistically significant ($P<0.05$). As shown in **Figure 2**.

Pain grading

When compared with the control group, the number of patients who felt painless after operation in experiment group were distinctly increased ($P<0.05$); the number of patients who felt severe pain after operation in experimental group was obviously decreased, and

patients' pain sensation after operation in experimental group was significantly relieved. As shown in **Figure 3**.

Discussion

The 125I radioactive seed can abidingly emit a kind of low energy gamma-ray, which has ionization effect on histiocytes. Moreover, this gamma-ray can persistently destroy the DNA double chain structure of tumor cells, influence the DNA replication of cancer cells and then inhibit the proliferation of tumor cells, so as to achieve the purpose of cancer treatment. The therapeutic effect of 125I radioactive seed in the treatment of spinal malignant tumors has been confirmed. With the advantages of wide spread application, small trauma and fewer complications, it is suitable for some patients who have advanced age, multiple primary diseases, multiple lesions, bone destruction intolerance, or patients who undergo repeated chemotherapy and bone cement therapy or surgical resection [15, 16]. 125I radioactive seed implantation has been widely employed in the treatment of malignant tumors, and is gradually replacing the surgery, radiotherapy and chemotherapy [17, 18]. At present, the most common types of metastatic tumors can be divided intolumbar vertebrae and thoracic vertebrae, and around 70% of patients with primary cancers are found to have vertebral metastases. The operation of 125I radioactive seed implantation has a good effect on the treatment of paravertebral and adnexal tumors, and can effectively control the tumor metastasis [19, 20]. The 125I radioactive seed has small damage to the surrounding healthy tissues and there is no adverse reaction on the whole, because what it continuously releases is a low energy ray and it is directly implanted into the lesion. Meanwhile, due to the long half-life of radioactive seed, the lesion tissues can be irradiated continuously and effectively, DNA in tumor cells can be destroyed for 24 hours without stopping to kill the tumor cells. Hence, 125I radioactive seed implantation can relieve the pain in treating the vertebral tumors and then effectively control the development of tumors. Under the CT guidance, the blood vessels and organs around the tumor are showed clearly, which can effectively ensure the accuracy of the position and depth of the implanted needle. Therefore, the CT-guided 125I radioactive seed implantation has become the main clinical treatment at present. And the clinical treatment results have shown that this new treatment can bring satisfactory results to the patients' postoperative recovery and treatment [21].

In this study, 24 patients with malignant vertebral tumor underwent conventional surgical treatment while another 24 patients were performed with the 125I radioactive seed implantation. And the comparison result of these two groups showed that the total effective rate in the treatment group (experimental group) that underwent CT-guided 125I radioactive seed implantation was significantly higher than that in the group (control group) that experienced conventional surgery ($P<0.05$). Moreover, the SDS score, PSQI score and NIHSS score in the experimental group were also significantly lower than those in the control group ($P<0.05$). Therefore, this study confirmed that the CT-guided 125I radioactive seed had remarkable therapeutic effects in the treatment of spinal malignant tumor. It could effectively control the local recurrence and expansion of tumor, reduce the patient's cancer pain to a large extent, decrease postoperative complications, prolong the survival time of patients and significantly improve the patients' quality of life. 125I radioactive seed implantation is an approach for local treatment, and if it is combined with the systemic treatment of the tumor, we are bound to obtain satisfactory results for the control of local lesions and metastasis in advanced malignant spinal tumors [22]. Therefore, in this study, we aimed to further investigate the therapeutic effects of 125I radioactive seed implantation combined with systemic treatment in the treatment of malignant spinal tumors.

In summary, CT-guided 125I seed intratumoral radiation therapy can effectively treat the spinal malignant tumor, relieve the cancer pain, reduce the scores of SDS, PSQI and NIHSS, and significantly improve the patients' life quality, which is effective in delaying the development of tumor disease. Therefore, it is worthy of clinical promotion and application.

Disclosure of conflict of interest

None.

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