Int J Clin Exp Med 2017;10(4):7000-7005
www.ijcem.com /ISSN:1940-5901/IJCEM0048608

Original Article

Comparison of application of CT-guided radiofrequency ablation and open surgery in the treatment of osteoid osteoma of the spine

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Received January 11, 2017; Accepted February 24, 2017; Epub April 15, 2017; Published April 30, 2017

Abstract: Objective: To compare the clinical efficacy of CT-guided radiofrequency ablation and open surgery in the treatment of osteoid osteoma of the spine. Methods: From June 2012 to June 2016, 45 patients with osteoid osteoma of the spine were treated with CT-guided radiofrequency ablation in 23 cases (Group A) and open surgical resection in 22 cases (Group B). The out-of-bed activity time, visual analogue scale (VAS) in preoperative and postoperative time points, postoperative complications, postoperative antibiotic use, length of hospital stay, total cost, the recurrence rate at two years after operation and other clinical data were compared between the two groups and retrospectively reviewed. Results: The difference in the recurrence rate at one year after operation between Group A and Group B was not statistically significant (P<0.05). And there was no postoperative complication in Group A and Group B. However, patients in Group A had the higher satisfaction degree than Group B (P<0.05). The out-of-bed activity time in Group A was earlier than that of Group B (P<0.05). The antibiotic use in Group A was less than that in Group B (P<0.05). The hospitalization time of Group A was shorter than that of Group B (P<0.05). The total hospitalization cost of Group A was lower than that of Group B (P<0.05). The VAS score of Group A was lower than that of Group B at two hours, three days, one week, one month and three months after operation (P<0.05). There was no significant difference in VAS score between preoperative and postoperative six months and one year after operation (P>0.05). Conclusion: The surgical safety of CT-guided radiofrequency ablation for osteoid osteoma of the spine is similar to open surgery, but its economic effect and patient comfort are better than those of open surgery. Therefore, CT-guided radiofrequency ablation is a simple, minimally invasive, safe and efficient method in the treatment of spine osteoid osteoma, which is worth promoting.

Keywords: CT-guided radiofrequency ablation, open surgery, spinal osteoid osteoma

Introduction

Osteoid osteoma is a kind of benign tumor, the relevant medical scholars gave a first report in 1935 [1, 2]. Adolescent has a high incidence of osteoid osteoma, whose main clinical manifestation is pain [3-5]. Load-bearing bone (such as the bone of lower extremity, pelvis and vertebral body, etc.) is the most common site of osteoid osteoma [6]. Currently, surgery is the main method for the treatment of osteoid osteoma. But due to the shortcomings such as inaccurate positioning, large surgical wound, incomplete tumor resection, etc., many studies have introduced radiofrequency ablation technique into the osteoid osteoma of the limbs bone, which has achieved good therapeutic effect [7-9]. However, there were rare studies for CT-guided radiofrequency ablation in the treatment of osteoid osteoma of the spine, so in this study we compared the clinical efficacy of CT-guided radiofrequency ablation and open surgery in the spinal osteoid osteoma and finally found that the former had more advantages than the latter. Here comes the report.

Materials and methods

Materials

Forty-five patients who were first diagnosed with osteoid osteoma of the spine in our hospi-

Table 1. Comparison of general data between two groups

Projects	Classification	Group A (n=23)	Group B (n=22)	x^2	t	P
Gender	Male	18 (78.3%)	16 (72.7%)	0.186		0.247
	Female	5 (21.7%)	6 (27.3%)			
Age (years old)		16.4±3.5	17.2±3.6		0.75584	0.89
Course of disease (years)		1.1±0.2	1.2±0.4		1.06787	0.36
Tumor locations	Sacral vertebra	10 (43.5%)	11 (50.0%)	0.192		0.214
	Cervical vertebra	7 (30.4%)	6 (27.3%)	0.055		0.251
	Lumbar vertebra	6 (26.1%)	5 (22.7%)	0.069		0.262
Accompanying symptoms	Mild scoliosis	7 (30.4%)	6 (27.3%)	0.055		0.251
	No	16 (69.6%)	16 (72.7%)	0.055		0.251

tal from June 2011 to June 2015 were selected for this study. All the patients had mild activity limitation, local pain and other clinical symptoms, were diagnosed as spinal osteoid osteoma by CT, MR examination and biopsy with informed consent. All the patients with disc herniation, infection, surgical contraindications and other pathogenic factors were excluded. These patients were randomly divided into CT-guided radiofrequency ablation group (Group A, n=23) or open surgical resection group (Group B, n=22). As for Group A, there were 18 males and 5 females, aged 8-36 (mean 16.4±3.5) years. The disease duration was 8 months to 2 years (mean 1.1±0.2 years). As for the tumor site, 10 patients were sacral vertebrae, 7 patients were cervical vertebrae and 6 patients were lumbar vertebrae. As for the complication, 7 patients were mild painful scoliosis but 16 patients were not. In Group B, there were 16 males and 6 females aged 9-36 (mean 17.2±3.6) years. The duration of disease was 9 months to 2 years (mean 1.3±0.4 years). As for the tumor site, 11 patients were sacral vertebrae, 6 patients were cervical vertebrae and 5 patients were lumbar vertebrae. As for the complication, 6 patients were mild painful scoliosis but 16 patients were not. As for the general information of the two groups of patients, the difference was not significant (P>0.05), which was comparable (**Table 1**).

Methods

Patients of Group B underwent open surgical resection while patients of Group A underwent CT-guided radiofrequency ablation. The specific operation was as follows. After being monitored with echocardiogram, the patients were in prone position, applied 64-slice spiral CT (US, GE Company) to scan and determine the best puncture level. With routine disinfection of drape, patients were treated with local infiltration anesthesia. The 11 G Traplok bone biopsy needle (Angiotech, USA) was used as a puncture device to puncture the osteoid osteoma center layer by layer. 18 G Cooltip radiofrequency electrode and radio frequency generator (Tyco, USA) were used as radiofrequency devices to introduce tumors along the bone marrow cavity into the tumor, the diameter of which was 1 mm or so, and gradually heated to 90°C. Then, after the constant temperature for 4 min, continued ablation was applied. During operation, patients' discomforts were observed at any time and it was ready to stop the ablation if any discomfort occurred. After completing the ablation, radiofrequency needle electrode was pulled out and sterile dressing was used to cover the puncture point to complete the operation. Postoperative antibiotics were applied reasonably and scientifically, in order to effectively prevent infection and record the amount of antibiotics of the patients.

Observation index

The postoperative follow-up time was 12 months. The data such as the spontaneous out-of-bed activity time, preoperative and postoperative VAS scores of two hours, three days, one week, one month, three months, six months and one year, postoperative complications, postoperative use of antibiotics, hospital stay, the total cost, other clinical data and follow-ups of the two groups, were collected and retrospectively analyzed. The visual analogue scale (VAS) was used to assess the pain of patients, in which 0 to 10 was on behalf of varying degrees of pain, 0 point for no pain, and 10 points for severe pain [4]. In addition, the incidence of postoperative complications (spinal

Table 2. Comparison of recurrence one year after operation and postoperative complications between two groups

Groups	Number	Recurrence after one year	Postoperative complication
Group A	23	0 (0)	0 (0)
Group B	22	1 (4.5%)	0 (0)
χ^2		1.022	0.978
P		0.489	0.511

cord injury, hemorrhage, fever, infection) in the two groups was statistically analyzed.

Satisfaction scores

The investigation about patients' postoperative satisfaction was carried out by using the self-designed satisfaction questionnaire at three days after operation, and the main content of questionnaire included: intraoperative discomfort, postoperative treatment effect, adverse reaction, body recovery and so on. The total score of questionnaire was 100 points. 81 to 100 points meant patients were highly satisfied with the treatment; 61 to 80 points meant patients were generally satisfied; and score below 60 points meant patients were not satisfied. Patients' satisfaction degree = (the number of cases with high satisfaction + the number of cases with general satisfaction)/total number of cases * 100%.

Statistical analysis

Software SPSS20.0 was adopted for statistical analysis. Postoperative spontaneous out-of-bed activity time, antibiotic consumption, hospital stay, hospitalization costs, VAS score and other measurement data of patients in two groups were expressed by using standard deviation ($\overline{X}\pm S$) and tested with the *t* test. The recurrence, the incidence of postoperative complications and other measurement data of the same period of the two groups of patients was expressed by ratio (%) and tested with the χ^2 test. The test standard was a=0.05, and P<0.05 was regarded as statistically significant.

Results

Comparison of surgical safety between two groups

There was no recurrence within one year in Group A and one in Group B. There was no significant difference between the two groups (P>0.05). There was no postoperative complication in both groups (**Table 2**).

Comparison of satisfaction degree between two groups

According to the survey of patients' satisfaction and statistical analysis, 20 cases in Group A were very satisfied, one case showed general satisfaction, and two cases were not satisfied with the treatment satisfaction degree of patients in Group A was 91.3% while the satisfaction degree of patients in Group B was 63.6%, the difference was statistically significant (P<0.05) (**Table 3**).

Comparison of surgical and economic results between two groups

The postoperative out-of-bed activity time of Group A was earlier than that of Group B (P<0.05), the antibiotic use of Group A was less than that of Group B (P<0.05), length of hospital stay of Group A was less than that of Group B (P<0.05), and the total hospitalization cost of Group A was less than that of Group B (**Figure 1**).

Comparison of surgical VAS score between two groups

Both groups had a certain degree of pain before surgery. The pain of Group A was relieved one day after operation and the pain of Group B was relieved one week after operation. VAS scores of two hours, one day, three days, one week and one month after operation in Group A were lower than those of Group B (P<0.05). There was no significant difference in VAS scores between two groups in six months and one year before and after operation (P>0.05) (**Figure 2**).

Discussion

With low incidence, osteoid osteoma accounts for 12% in the benign bone tumors is [10]. Osteoid osteoma can occur in any body bone, mainly occurs in long bone and vertebrae [11-13]. In the active stage of osteoid osteoma, there is significant pain at the osteogenic tumor site of the patients and generally the application of non-steroidal anti-inflammatory drugs can significantly relieve the pain [14]. Non-steroidal anti-inflammatory drug therapy can not completely eradicate osteoma, resulting in

Table 3. Comparison of satisfaction degree between two groups

Group	High satisfaction	General satisfaction	Dissatisfaction	Satisfaction degree
Group A (n=23)	20	1	2	91.3%
Group B (n=22)	13	1	8	63.6%
χ^2				4.98
P				0.026

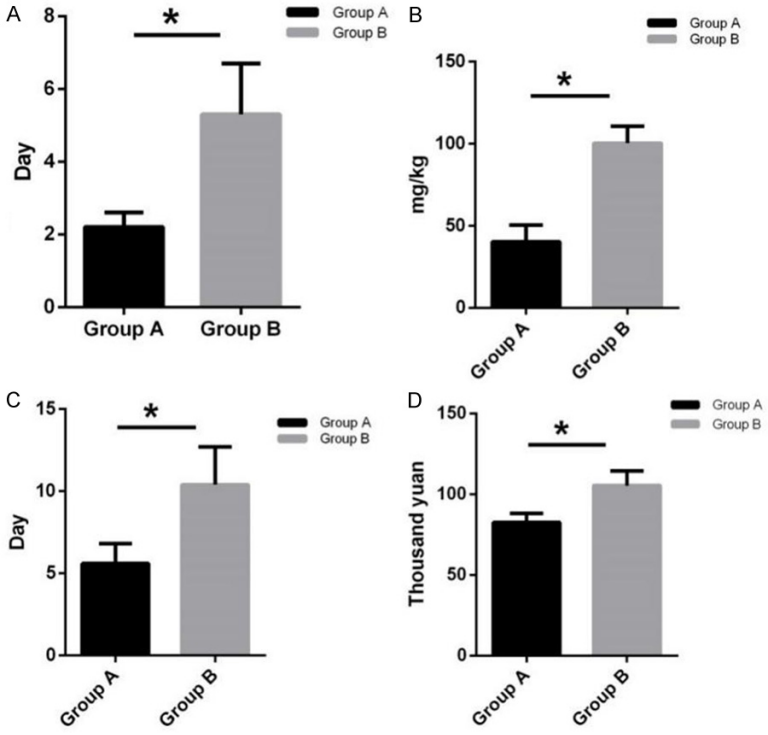

Figure 1. Comparison of spontaneous out-of-bedtime after operation, antibiotic capacity, concurrent recurrence, length of stay, hospitalization expenses between two groups. Note: *Compared with Group B, P<0.05.

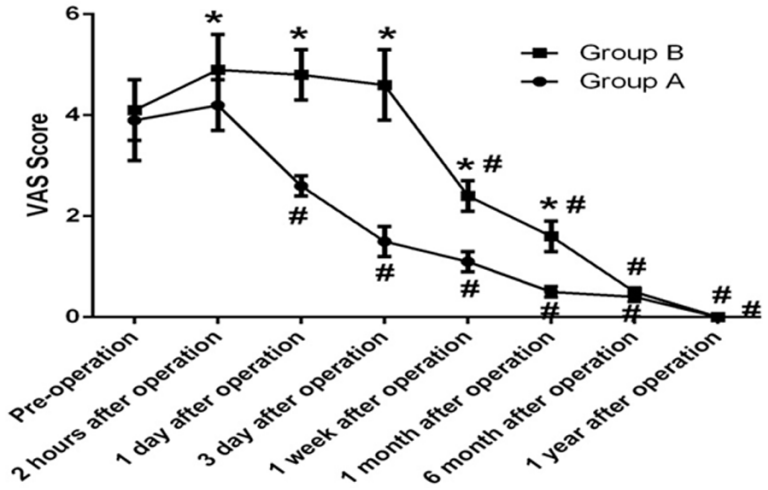

Figure 2. Comparison of VAS scores before and after operation between two groups. Note: *Compared with Group A at the same time point, P<0.05; #Compared with pre-operation in the same group, P<0.05.

the repeat of clinical symptoms of patients [15]. Therefore, the most commonly used and radical method for osteoid osteoma is the surgical resection. Open surgery is the most commonly used surgical method, but there are many shortcomings, such as large trauma, inaccurate positioning and patient discomfort [16, 17], so clinicians are exploring a variety of minimally invasive surgical methods for effective positioning.

At present, many clinicians introduce CT-guided percutaneous radiofrequency ablation into the treatment of limb bone osteoid osteoma and find that this method has exact therapeutic effect. This therapeutic method is minimally invasive with high safety, which can effectively shorten the patient's hospital stay, speed up the patient's postoperative recovery rate [18]. Other medical studies have shown that, compared with open surgery, CT-guided radiofrequency ablation can reduce medical costs with a higher cost performance. Spine structure is complex, and spinal osteoid osteoma growth, spinal cord, blood vessels and others are closely adjacent. So it is more difficult to accurately locate complete resection of osteoma by using open surgery, which can very easily lead to incomplete resection or normal bone tissue removed [19, 20]. However, at present, the studies on CT-guided radiofrequency ablation for the treatment of spinal osteoid osteoma are very rare.

This study compared the clinical results of CT-guided radiofrequency ablation and open

surgery for the treatment of spinal osteoid osteoma, the results showed that the differences of the recurrence rate and the incidence of complications within one year between the two groups of patients were not statistically significant, indicating that the treatment effect of CT-guided radiofrequency ablation was similar to the open surgery; the time of spontaneous out-of-bed activity, the amount of antibiotics, the total hospitalization time and the total cost of hospitalization of CT-guided radiofrequency ablation group were all better than those of open surgery group, showing that CT-guided radiofrequency ablation had a better economic efficiency; postoperative VAS scores and satisfaction degree of CT-guided radiofrequency ablation group were better than those of open surgery group, confirming that patients treated with CT-guided radiofrequency ablation had higher degree of comfort.

In summary, CT-guided radiofrequency ablation and open surgery has similar safety to treat spinal osteoid osteoma, but the economic efficiency and patient comfort are better than those of open surgery. Therefore, with simplicity, minimal invasion, safety and efficiency, CT-guided radiofrequency ablation is worth promoting. However, the number of clinical samples included in this study is relatively small, and the clinical follow-up time is relatively short. Therefore, more samples should be included in long-term studies in order to obtain more reliable results to guide clinical practice.

Disclosure of conflict of interest

None.

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