Cryobiology 69 (2014) 169–173

Contents lists available at ScienceDirect

Cryobiology

journal homepage: www.elsevier.com/locate/ycryo

The treatment of paravertebral malignant mesenchymal tumor pain with cryoablation ☆

Y. Li, Z. Guo *, H.T. Wang, W.G. Xing, X.L. Yang, C.F. Liu

Department of Interventional Therapy, Tianjin Medical University Cancer Institute and Hospital, China

ARTICLE INFO

Article history:
Received 8 March 2014
Accepted 9 July 2014
Available online 15 July 2014

Keywords:
Cryoablation
Paravertebral
Mesenchymal
Tumor
Pain

ABSTRACT

Objective: The purpose of this study was to evaluate the feasibility, safety, and efficacy of cryoablation to treat pain from paravertebral malignant mesenchymal tumors.
Method: Cryoablation was performed on 15 patients who suffer from unresectable painful paravertebral malignant mesenchymal tumors and whose pain was poorly controlled by conventional treatment methods. The sizes of the tumors varied from 3 to 20 cm. The patients' pain at baseline before the cryoablation and the pain they felt 1 day, 1 week, 1 month, and 3 months after the cryoablation were assessed respectively by the Brief Pain Inventory (BPI).
Result: BPI scores are divided into two categories: the influence of pain and the severity of pain. Both results showed a decline after the cryoablation. The evaluation score of pain severity decreased significantly ($P = 0.001$, $P = 0.031$) on the observation of 1 day and 1 month after the cryoablation; that of pain influence decreased significantly ($P = 0.016$, $P = 0.036$) in the cases of 1 day and 1 week after cryoablation. Two patients (13.33%) had mild complications, but no serious complications occurred.
Conclusion: Cryoablation is a low risk, well-tolerated topical treatment for the pain of patients with unresectable paravertebral malignant mesenchymal tumor.

Introduction

Severe pain is common for patients with paravertebral malignant mesenchymal tumor. Although there are many palliative treatment options, most of the treatments cannot avoid side effects or achieve satisfying results. With the dose increase in applying opioid and non-opioid drugs, the side effects caused by using such doses become unbearable. The treatment which attempts to reduce the tumor load by adopting palliative radiotherapy, chemotherapy and surgery could often be unavailable because of the anatomical location of the paravertebral tumors, the restriction on the use of the radiation dose, chemotherapy drug toxicity and the patients' failed physical conditions of taking the surgery. Patients with intractable pain need other treatment options to maximize pain control and reduce pain. A variety of minimally invasive treatment technology has been used in the treatment of pain, including radiofrequency ablation, and other chemical ablation methods such as anhydrous ethanol [11]. Nerve damage is probably the main reason for patients' pain relief [16].

Cryoablation therapy provides a new treatment for cancerous pain [10], which has been successfully applied in the clinical treatment for prostate cancer and other malignant tumors for over a decade [4]. It has been reported that cryoablation therapy can effectively inhibit the bone pain caused by metastatic carcinoma [14]. No reports have been found concerning the effect of the treatment for the paravertebral malignant mesenchymal tumor pain. Cryoablation therapy can achieve rapid effect of partial melting, and thus can theoretically reduce the dosage of anesthetic drugs for patients in pain and provide a new treatment option for patients suffering from cancerous pain. The purpose of this study was to evaluate the short-term curative effect and safety of the cryoablation therapy for paravertebral malignant mesenchymal tumor pain.

Materials and methods

Patients' information

From 2002 to 2012, the study treated and traced 15 patients, with 6 male cases and 9 female cases, aged from 25 to 72. The

☆ *Statement of funding:* This work was supported in part by the National Natural Science Foundation of China (No. 81001002), Tianjin Natural Science Foundation (No. 09JCYBJC10400).

* Corresponding author.
E-mail address: ktwzkr@yeah.net (Z. Guo).

http://dx.doi.org/10.1016/j.cryobiol.2014.07.006
0011-2240/

average age of the patients was 56, and median age was 58. Pathological types included: liposarcoma (5 cases), fibrosarcoma (3 cases), malignant fibrous tissue hyperplasia (2 cases), synovial sarcoma (2 case), myxoid fibrosarcoma (1 case), inflammatory myofibroblastic tumor (1 case), and malignant giant cell tumor of bone (1 case). Tumors' diameter ranged from 3 to 20 cm.

Main treatment equipments

Endocare: Cryocare Surgical System.
Toshiba: 16-slice spiral CT scanner.

Therapeutic method

Cryoablation therapy: All patients in the study group were treated with partial anesthesia. After the anesthesia had taken effect, the patients were put into a prone position, regular disinfection with sterile towels was applied to the surgical site. According to the tumor size and its location, 2–4 cryoprobes with diameter of 2 mm were adopted. With the help of CT image guided technology, percutaneous puncture was carried out to enable the cryoprobes to conform within the tumor. The cryoablation covering the scope of the tumor was valuated and confirmed. The process was monitored with CT; according to the expansion velocity and range of cryoablation, the output power was adjusted to control the temperature within the range of −45 °C to −120 °C (the temperature of the probes). Thaw with helium for 12–15 min, to complete the first round circulation therapy. Repeat the treatment above for the second time. All operations are monitored with CT, ECQ, respiration, pulse and blood oxygen saturation. After the operations, partially press the puncture point for 10 min.

Follow-up and effect evaluation

Assess the patients' preoperative baseline and the pain the patients suffered from 1 day, 1 week, 1 month and 3 months after cryoablation with Brief Pain Inventory (BPI). Record in detail the follow-up examination of patients with postoperative complications.

Statistical processing

The statistical analysis was carried out by the software package GraphPad Prism 5. Sample mean analysis was tested using Wilcoxon. When $P < 0.05$, it was announced to have a statistical significance.

Result

BPI score statistics

For the specific evaluation of each classification, the scores of all items gradually decline over time (Table 1).

The data shows that, compared to preoperative pain severity baseline, the relief of severity of pain showed statistical difference ($P = 0.001$) 1 day after the cryoablation. Compared with 1 day post operation, the patients' severity scores of 1 week post operation dropped, but the difference was not statistically significant ($P = 0.052$). The pain severity scores 1 month post operation decreased significantly ($P = 0.031$) compared to the scores of 1 week post operation. Patients' average and median pain severity scores 3 months post operation lowered, compared with the scores of 1 month post operation, but the difference of average pain severity scores was not statistically significant ($P = 0.070$) (Fig. 1). In terms of the results of pain inference scores, there was a significant reduction in the scores of 1 day and 1 week post operation, ($P = 0.016$, $P = 0.036$). Although the patients pain inference scores of 1 month and 3 months after cryoablation also dropped, they were not statistically significant ($P = 0.051$, $P = 0.092$) (Fig. 2).

Typical cases

After cryoablation therapy, not only was the pain brought under control, some patients also received additional therapeutic benefit.

Case 1: A 24-year-old female patient, who was diagnosed with recurrence after radical resection of malignant giant cell tumor of bone, had lumbar stent fixation (Fig. 3). Before the cryoablation treatment, the average pain severity score was 9 and the average pain influence score was 8.14. The patient had been long in bed due to the continuous pain. To reduce the pain, palliative cryoablation was performed to deal with the paravertebral tumor, and the ice ball did not cover the entire tumor, as is shown in Fig. 4. One month after the operation, the patient felt obvious pain relief. The average pain severity score was 2.25 and the average pain influence score was 2.28. The patient stopped using painkillers and regained her walking ability. With enhanced CT follow-up, most of the tumor was in necrosis. Necrotic range was larger than cryoablation scope and only the peripheral part of the organization was in mild enhancement (Fig. 5). After the treatment, the patient was in stable condition. The long-term follow-up has been more than four years and the tumor has not been seen to obviously change.
Case 2: A 56 year old female patient, diagnosed with left thoracic paravertebral tumor. Pathology result diagnosed by aspiration biopsy was synovial sarcoma (Fig. 6). Before the cryoablation therapy, the average score of pain severity was 6.75, and the average pain influence score was 6 points. To control the pain, palliative cryoablation was performed to treat the paravertebral tumor, and the ice ball did not cover the entire tumor (Fig. 7). One week after the operation, the patient experienced a significant pain relief. The average pain severity score was 3.14 and the average pain influence score is 3.25. Then the pain was gradually reduced. One month after cryoablation, an enhanced CT follow-up was performed, which showed that the extensive tumor was in necrosis. Necrotic range was larger than cryoablation scope, and tumor diminished, as is shown in Fig. 8. Short-term follow-up of 3 months showed that the pain had basically disappeared, and patient was in a stable condition.

Cryoablation safety evaluation

Cryoablation was effective with a high safety rate in the treatment of paravertebral malignant mesenchymal tumor, and postoperative complications were rare. Of all the patients in this group, only 2 cases had minor complications after the surgery (2/15, 13.33%). One patient showed body temperature rising on the next day of the surgery (up to 39 °C). The laboratory test did not support infection diagnosis. The body temperature returned to normal 3 days after lowering body temperature treatment. One patient had a small amount of pneumothorax, which alleviated itself without processing. This group did not show other serious complications.

Discussion

As a minimally invasive, highly efficient and low toxicity targeted ablation treatment, CT guided cryoablation therapy attracts more and more tumor clinical attention. Cryoablation can kill the tumor tissue by forming a cryogenic environment in a short time, and thus effectively reduce the tumor load. In the early 90s, the