

Analysis of the Target Motion Degree Measure of Primary Tumor of Esophagus Cancer

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Abstract: Cancer is horrible for everyone, as it's hard to be cured completely with quite high recurrence rate. To make better monitoring and therapy to the target of primary tumor of esophagus cancer, it's necessary to analyze how to measure the target motion degree of primary tumor of esophagus cancer. With references of 32 patients of esophagus cancer, based on the basic parameter of target motion degree measure of primary tumor of esophagus cancer, and relying on experiment of measure, the measure data are obtained. The measure is performed with the expectation to find out the effectiveness of target motion degree measure of primary tumor of esophagus cancer.

Keywords: Esophagus cancer; Target of primary tumor; Motion degree; Measure

1. Introduction

Nowadays, with the increasingly refined technology of image-guided setup error online correction, its treatment for esophageal cancer has increasingly exerted a tremendous influence. Early treatment to patients of esophageal cancer can achieve similar efficacy with traditional methods after radiotherapy. Long-term follow-up visit to postoperative of esophageal cancer is an important means to monitor the patient's physical condition [1]. However, from the existing studies, many postoperative patients have high degree of recurrence, and the main site of recurrence is in the target area of primary tumor of esophageal cancer or its adjacent area. Whether radiotherapy is performed or not is not significant for sites other than the primary tumor target area [2]. Therefore, the long-term follow-up visit to postoperative patients is mainly focused on the location of the primary tumor target area of esophageal cancer [3]. With the various types of clinical use and detection of 4D_CT scan methods in recent years, it has been found to have great advantages in monitoring the movement of esophageal cancer in the target region of the primary tumor or in the vicinity thereof. This study mainly focused on the determination of the primary tumor target area of esophageal cancer and the motion degree measurement. The low-risk patients after early radiation therapy for esophageal cancer are selected to perform three-dimensional conformal radiotherapy for some cancer areas, the area is determined by color B ultrasound, the range of motion of the primary tumor target area was tested by 4D-CT scanning.

2. Measure Materials and Methods of Target Motion Degree of Primary Tumor of Esophagus Cancer

2.1. Case information

There are 32 patients who had undergone esophageal cancer radiotherapy at our hospital from June 2015 to June 2017 selected, all of them had undergone repetitive 4D-CT scans in our hospital. Among them, there are 26 men and 6 women. To ensure the accuracy of the experiment, the age of the patients to be selected is in the middle age period, namely, 40 to 60 years old (average age is 48 years old). The cancer time and treatment time of these patients is more than one year. They were 9 patients with cancer in the upper chest, 16 with cancer in the middle of the chest, and 7 with cancer in the lower chest. All selected cancer patients were subjected to 4D-CT scan before radiotherapy to simulate the localization. It should be ensured that all selected patients whose cardiopulmonary function is normal follow their will, and are informed the experiment content and willing to sign informed consent.

2.2. CT scan and image acquisition

The selected patients with cancer in the upper chest should choose soft headrest for fixation of head, neck and shoulder, whose hands should be put in two sides of the body; the selected patients with cancer in the middle of the chest and lower chest choose negative pressure bag to fix the body, whose hands are upward [4]. The 4D-CT scan is used to detect the cancerous area under free breathing condition, the scanning time is more than 60s.

At the same time, attention is paid to the Varian real-time position management system when scanning, the respiratory signal recorded by this system is set as 10 phases to decompose the CT map.

2.3. Target motion degree

The selected 32 patients were subjected to 4D-CT scan, the detailed parameters of patients under different respiratory phases are measured and the maximum value of motion of various directions is taken as the target motion of the direction [5].

3. Measure of Target Motion Degree of Primary Tumor of Esophagus Cancer

3.1. Confirmation of Gross Tumor Volume (CTV)

Using professional software, the target area is delineated under the conditions of a CT window width of 500 and a window level of 0. Attention is drawn to defining the surgical area based on the site of the cancer, the Gross Tumor Volume (GTV) of the primary tumor of the esophageal primary tumor is determined [6]. That is, the left and right sides of the surgical cavity outlined on each layer of the image include the lead points that appear on this layer, and the front and rear boundaries are determined by referring to the bed depth determined by the B-mode ultrasound.

3.2. Analysis of target motion degree measure

Throughout the experiment system, repetitive scans were performed on the initial 4D-CT scan. The time phase at T0 is taken as benchmark, all 4D-CT repeated scan images are compared. Under the same pane layout and the same window, the overall delineation of the images at each phase gives the GTV [7]. In such case, the wall thickness is controlled within 5 mm, or the gas-free diameter is within 10 mm. The professional software is used to find the GTV three-dimensional coordinates under the coordinate system with the same configuration, the maximum and minimum values of the target motion degree on the same coordinate system are selected, and the maximum motion degree of the GTV center point on a certain coordinate axis can be obtained by subtracting one from another [8].

Let the motion vector be V, and the three-dimensional coordinates of the GTV are x, y, and z. Then it can be

obtained that:
$$V = \frac{x^2 + y^2 + z^2}{2}$$

The motion vector under the GTV three-dimensional coordinates can be calculated according to equation 2.1; According to the above description, GTV10, the tumor volume, is obtained by averaging the GTV at 10 phases[9];

The solution can be obtained by the number of lesions × 3 mm, the lesion length of each phase can also be obtained [10];

At the same time, when computing the same 4D-CT scan results, the average length of GTV10 at 10 phases can be obtained, which is the tumor length [11];

By measuring the above mentioned parameters with professional software, the maximum transverse diameter of GTV at each phase of the same 4D-CT scan can be obtained, through contrast, the maximum transverse diameter of GTV of corresponding period can be analyzed [12].

3.3. Statistics method

The software SPSS 17. 0 is used to verify the three-dimensional directional motion of GTV in radiotherapy and motion vector as well as tumour volume, length, maximum transverse diameter and motion modification. P<0. 05 means that the difference is statistically significant.

4. Experimental Analysis

To prove the effectiveness of target motion degree measure of primary tumor of esophagus cancer in this paper, the experiment of measure is designed. The experimental results are as follows:

4.1. Experiment on the influence of clinical factors on the target motion degree of primary tumor

The influence of the gender, age and body mass index of patients on the three-dimensional directional motion of GTV [13]: if the difference of gender, age and body mass index exerts influence on the three-dimensional directional motion of GTV, details are shown in Table. 1.

Table 1. Influence of various clinical factors on the target motion degree of primary tumor with 32 patients of esophagus cancer

Parameters		Cases (patient)	Motion between right and left sides	Motion between front and back sides	Motion up and down
Gender	Male	26	0.15	0.12	0.34
	Female	6	0.12	0.09	0.31
Value X2			-0.75	-0.10	-0.07
Value P			0.476	0.956	0.967
Age	< 48 years old	14	0.15	0.10	0.30

	≥ 48 years old	18	0.14	0.11	0.28
Value X2			-0.05	-0.56	-1.02
Value P			0.926	0.552	0.267
Body mass index	< 21.97	15	0.15	0.12	0.35
	≥21.97	17	0.14	0.12	0.28
Value X2			-0.35	-0.16	-1.37
Value P			0.736	0.856	0.127

From Table. 1, it can be seen that with the target motion degree measure of primary tumor of esophagus cancer, the difference of gender, age and body mass index doesn't exert influence on the three-dimensional directional motion of GTV, namely, the cilinical factors such as gender, age and body mass index don't exert influence on the target motion degree measure of primary tumor of esophagus cancer.

4.2. Experiment on the influence of tumour features on the target motion degree of primary tumor

Based on the analysis of target motion degree of primary tumor in 2.4, the tumour length, lesion length, tumor volume and tumour subsection are analyzed [14]. The contrast of various groups of three-dimensional directional motion of GTV after grouping is shown in Table. 2.

Table 2. Influence of tumour features on the target motion degree of primary tumor with 32 patients of esophagus cancer

Parameters		Cases (patient)	Motion between right and left sides	Motion between front and back sides	Motion up and down
Tumour subsection	Upper section	8	0.12	0.08	0.23
	Middle section	13	0.11	0.08	0.30
	Lower section	11	0.22	0.19	0.38
Value X2			6.75	8.10	4.07
Value P			0.036	0.016	0.120
Tumour length	<4.5cm	24	0.17	0.12	0.30

	≥4.5cm	8	0.14	0.11	0.32
Value X2			-2.05	-0.26	-1.12
Value P			0.046	0.852	0.262
Lesion length	<10cm	25	0.13	0.12	0.30
	≥10cm	7	0.24	0.21	0.42
Value X2			-2.35	-3.16	-2.37
Value P			0.006	0.000	0.017
Tumour volume	< 20cm ³	18	0.16	0.13	0.32
	≥20cm ³	14	0.14	0.12	0.30
Value X2			-0.55	-0.26	-0.57
Value P			0.536	0.756	0.628

From Table. 2, the target motion degree of primary tumor of esophagus cancer in lower chest between right and left sides as well as front and back sides is obviously larger than that in upper and middle section, while the motion degree between up and down in the upper, middle and lower section is similar [15]; the lesion length of primary tumor exerts influence on motion degree of various direction of GTV; the difference of primary tumor length only exerts influence on the motion degree of GTV between right and left sides, but no influence on that between front and back sides as well as up and down; while the difference of primary tumor volume doesn't exert influence on motion degree of GTV in all directions.

With the above experimental results, the measure and analysis of target motion degree of primary tumor of esophagus cancer are well applied in motion degree of GTV in all directions under various influences.

5. Conclusion

The experiment on target motion degree of primary tumor of esophagus cancer analyzed in this paper has detailed analysis on how to perform the experiment and formulate the experimental methods. To prove the effectiveness of experimental method, analysis of experiment are conducted, clinical factors and primary tumor features are tested, and the experimental data show that the target motion degree measure of primary tumor of esophagus cancer is quite feasible and can be well applied in analysis of motion degree of target of primary tumor.

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