



Examination of therapeutic risk factors for radiotherapy interruption

Huei-Fan Yang^{1,2,3}, Ying-Hsiang Chou^{1,4}, Hsueh-Ya Tsai², Hsien-Chun Tseng^{1,5}, Hsin-Lin Chen¹, Yueh-Chun Lee^{1,5}

¹Department of Radiation Oncology, ²Department of Nursing, Chung Shan Medical University Hospital, Taichung, Taiwan; ³School of Biomedical Sciences, ⁴Department of Medical Imaging and Radiological Sciences, ⁵School of Medicine, Chung Shan Medical University, Taichung, Taiwan

Correspondence to: Yueh-Chun Lee. Department of Radiation Oncology, Chung Shan Medical University Hospital, No.110, Sec.1, Jianguo N. Rd., Taichung City 40201, Taiwan. Email: lee.yuehchun@gmail.com.

Abstract: As cancer treatment continuously improves, survival rates after treatment have also drastically improved. However, the reasons patients do not complete the entire courses of treatment and the qualities of life of patients receiving radiotherapy are seldom examined. In this study, the fishbone diagram analysis was used to retrospectively examine the interruption factors in our department. Then, we provided more nursing interventions in the future to alleviate discomfort in patients and improve treatment completion rates. The overarching goal was to provide a reference for nursing staff to improve nursing quality during radiotherapy. The fishbone diagram analysis found four correlation factors causing radiotherapy interruption: patient factors (group A), event factors (group B), disease factors (group C), and device factors (group D). The side effects caused by radiotherapy (which belong to group C factors) accounted for 29.3% (68 patients), complications caused by cancer (also group C factors) accounted for 21.6% (51 patients), patient autonomy (group A factors) accounted for 22% (50 patients), and family factors (group A factors) accounted for 15.1% (35 patients). Radiotherapy side effects resulting in an inability to complete the full course of treatment were the biggest factor (68 patients/29.3%). The possible interventions to improve adherence to treatment include establishing procedures and patient record forms, monitoring body weight changes weekly and conducting regular blood draws, and incorporating personalized nursing health education and measures. Such interventions can help reduce discomfort caused by side effects and improve pain, nutrition, and oral mucositis. Staged nursing health education, referral to a nutritionist for the monitoring of the nutritional status during treatment, and follow-up on posttreatment status by cancer case managers can help effectively decrease discomfort caused by side effects. A multidisciplinary approach to care has been used to increase confidence in treatment among patients, and therefore, the interruption and non-completion rates decreased from 30% (232 in a total of 764 patients treated) and 65% (150 in a total of 232 patients with interruptions) in 2016 and 28% (229/817) and 38% (87/229) in 2017 to 26.8% (243/907) and 33% (80/243) in 2018.

Keywords: Radiotherapy; cancer; fishbone diagram; interruption

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Introduction

Cancer incidence has continuously increased over the years, mainly because of population aging, unhealthy lifestyle, and promotion of cancer screening. Survival rates have also greatly increased through the continuous upgrading of cancer treatment techniques, along with various treatment

regimens formulated in response to problems caused by tumors. However, patients' lack of cooperation and adherence to treatment may be life-threatening. Generally, the rate of cancer treatment interruption is 4–27% (1), and the risk of death increases when treatment is interrupted (2). Cancer has a huge psychological and physiological impact

on patients and their family members. However, the reasons for cancer treatment interruptions are extremely complex. Side effects during treatment often reduce a patient's willingness to complete treatment, resulting in treatment interruptions (3). Several patients with head and neck cancer develop oral mucositis 2 to 3 weeks after the start of radiotherapy, causing eating difficulty and weight loss. Moreover, patients are in the hospital for short periods of time during outpatient radiotherapy, so they have insufficient time for health education or consultation from nursing staff. This may result in less recognition and therefore less control of side effects. Treatment interruption causes an increase in disease severity and the probability of cancer recurrence and metastasis, affecting treatment outcomes and subsequent disease survival rates, as well as society's medical costs (4). Therefore, this study examined the risk factors for treatment interruption in patients receiving radiotherapy, aiming to provide a reference for healthcare staff to reduce treatment interruptions in patients and increase survival rates.

Materials and methods

Patient data

We extracted data from the statistical database of our department on patients who received radiotherapy from January 1, 2016, to December 20, 2016. In this study, we included the common types of radiation therapy cancer to comprehensively assess all aspects, not for a single specific cancer type or site. There was no limit to the types of radiation therapy, including curative or palliative treatment, with or without chemotherapy, and neoadjuvant, definitive, or adjuvant therapy. The fishbone diagram (Ishikawa diagram), created by Kaoru Ishikawa, was used to analyze correlations among branches. A cause-and-effect diagram helps managers to track down the reasons for imperfections, variations, defects, or failures. The causes are usually grouped into major categories to identify and classify these sources of variations. The diagram is similar to a fish's skeleton with the problem at its head and the causes of the problem feeding into the spine (5). Multiple strategies were used to increase interview duration and communication between patients and healthcare staff to solve the problem of insufficient time and health education. The goal was to provide complete, professional, high-quality nursing care.

Treatment interruption factors

The fishbone diagram analysis found four correlation

factors causing radiotherapy interruption: patient factors (group A), event factors (group B), disease factors (group C), and device factors (group D) (*Figure 1*). Patient factors (group A) include the use of other treatments (such as folk prescriptions), fear of complications, financial problems, and lack of coordination and support from family members. Event factors (group B) include long-distance and inconvenient transportation, family factors, and weather. Disease factors (group C) include side effects caused by radiotherapy (including chemoradiotherapy), changes in treatment regimen due to disease progression, and comorbidities caused by cancer. Device factors (group D) include change in treatment plan, mold factors (it may not fit correctly if weight changes), and equipment breakdown.

Nursing care aspects

Nutrition assessment and support

At our institution, during treatment, patients are usually scheduled to attend outpatient clinic appointments with the attending physician at least once a week, and body weight is measured weekly. Warning levels are set for weight loss: 5–10%. If weight loss reaches 5%, a specialist nurse from our department conducts personalized nutritional health education, and follow-up is performed in stages to assess whether feeding tube placement is necessary. A proactive meeting with the nutritionist is set up for nutritional guidance according to the patient's condition, and a follow-up booklet is used until body weight is stable after treatment ends. Early nutritional screening is performed to assess the nutritional status, and dietary guidance is provided so that patients receive a balanced diet high in calories (34 kcal/kg/day) and protein (1.5 g/kg/day) (6). Moreover, patients are instructed on the use of enteral nutrition, gavage formula preparation and correct intake, and advantages of eating small meals high in protein (meat, eggs, milk, and fish) to improve the nutritional status (7). Nurses listen to patients and encourage them to talk about dietary problems and assess dietary preferences to make appropriate selections. Moreover, they advise on how cooking methods can be changed, such as using gravy packets and adding seasoning. A selection of high-protein foods (e.g., tofu, eggs, and yogurt) is reviewed to encourage patients to eat and increase their willingness to eat, and the effectiveness of dietary interventions is also monitored (8). These interventions can prevent patients from developing cancer-related anorexia and cachexia syndrome and increase the cure rate.

Before radiotherapy is administered to patients, they

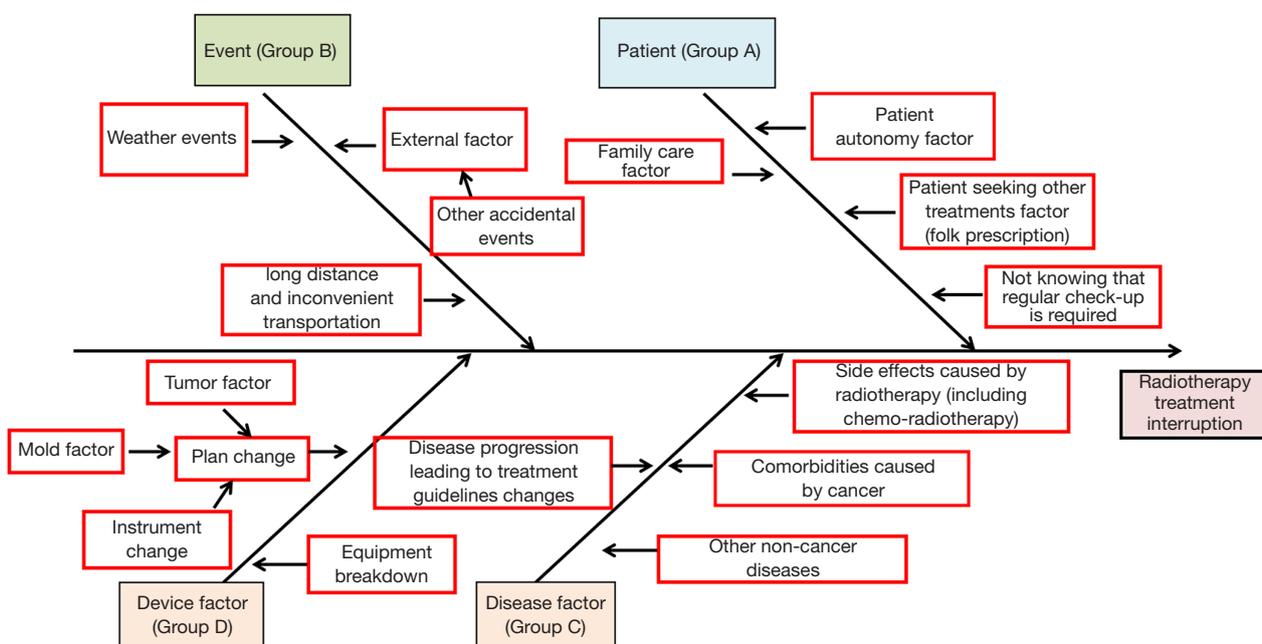


Figure 1 The fishbone diagram analysis found correlation factors causing radiotherapy interruption.

receive self-care health education. The radiotherapy nurse practitioner uses self-designed content to conduct health education. Nursing health education is oriented toward clinical services and takes into account each patient's availability. The radiation oncology nurse practitioner conducts personalized health education in a separate meeting space with sufficient time, besides providing different health education leaflets for various cancer types. The content of health education includes five stages: outpatient, radiotherapy procedure, treatment side effects, nursing measures, and self-care recommendations. During this period, self-made educational videos are played, providing personalized self-care for different sites, including skin, nutrition and hydration, pain, and exercise guidance. Health education sub-stages and open communication techniques are used so that nurses can understand the needs of patients and their family members and provide assistance. Nurses also apply teach-back methods after every health education lesson. During assessment, the degree of understanding by the patient is used for further intervention. The degree of understanding is divided into the following categories: 5 points, complete understanding; 4 points, understanding; 3 points, fair understanding; 2 points, partial understanding; and 1 point, not understood. Health education is again provided when a score is less than 4 points, focusing on the areas that were not

understood (*Figure 2*).

Prevention of acute side effects

The problems often caused by treatment include oral pain, pain during swallowing, reduced oral intake, and secondary infections, which frequently lead to treatment interruption and poor disease control (9). Oral mucositis is the most common side effect in patients with head and neck cancer receiving radiotherapy. It usually occurs 2 to 3 weeks after treatment starts and gradually subsides 2 to 3 weeks after treatment ends. Several patients with head and neck cancer receive concurrent chemoradiotherapy. At a dose of 1,500 cGy, oral cavity changes occur. At a dose of 3,000 cGy, oral ulcers occur. At 5,000–6,000 cGy, severe pain and discomfort occur for 2 to 3 weeks.

Nurses should help patients with oral mucositis by encouraging them to eat more protein, consume more vitamin C, and drink 2 L of water every day. Oral care is to be performed after meals and before sleeping. Crushed ice and anesthetic gargles can be used to alleviate discomfort and assist in eating. Moreover, spicy and acidic foods should be avoided. Furthermore, patients should consume soft and low-salt foods and reduce irritating foods.

The nurse cannot administer medicine. Therefore, besides nursing care and education, it is necessary to provide information to the attending physician as a reference to

Radiation Oncology Nursing Health Education Consultation Assessment Form

Medical record number: _____ Diagnosis: _____ Name: _____

Treatment starting date: _____

Weight: ____ kg (warning levels for weight loss: 5% ____ kg, 10% ____ kg)

	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8
Body weight								
WBC								
Hgb								

Health education instructed items	Time health education			1 st day of assessment			10 th day of health education			10 th day of assessment			25 th day of assessment		
	Date	Adviser	Instructed person	Date	Adviser	Instructed person	Date	Adviser	Instructed person	Date	Adviser	Instructed person	Date	Adviser	Instructed person
1. Outpatient and radiotherapy procedures															
2. Side effects and precautions during treatment															
3. Anatomical site self-care orientation															
4. Skin reaction self-care															
5. Nutrition and hydration															
6. Pain control orientation															
7. Rehabilitation exercise orientation															

Note: the degree of understanding: 5, complete understanding; 4, understanding; 3, fair understanding; 2, partial understanding; and 1, not understood.

Figure 2 Radiation oncology nursing health education consultation assessment form.

adjust the pain medicine.

Build trust

During treatment, patients are usually scheduled to attend outpatient clinic appointments with the attending

physician and nurse at least once a week. Fixed nursing care interventions accompany the whole treatment. With regard to these interventions, suitable health education should be provided, and distraction and relaxation techniques can be used to prevent, alleviate, or eliminate anxiety. Nurses

should use empathy to understand patients' perspective and provide positive feedback when certain tasks are completed to increase their sense of control and reduce uncertainty. A noncritical attitude should be taken toward patients' behavior, and nurses should be sincere to develop trust and harmonious relationships with patients (10).

Results and discussions

In the fishbone diagram analysis, the causes are usually grouped into major categories to identify and classify the sources of variations. The side effects caused by radiotherapy (group C factors) accounted for 29.3% (68 patients), complications caused by cancer (also group C factors) accounted for 21.6% (51 patients), patient autonomy (group A factors) accounted for 22% (50 patients), family factors (group A factors) accounted for 15.1% (35 patients), and other factors accounted for 12% (28 patients). Radiotherapy side effects resulting in an inability to complete the full course of treatment are the biggest factor causing treatment interruption.

A high proportion of patients have insufficient nutritional intake during treatment because of mouth pain, dysgeusia, and dysphagia, which reduce food consumption. The causes of these symptoms should be assessed as early as possible, and appropriate nursing measures should be provided. Pretreatment malnutrition aggravates symptoms after treatment (11). Cachexia tends to occur when there is excessive weight loss during treatment, which affects treatment outcomes and completion rates. Patients who are unable to complete the full course of treatment have insufficient treatment dose and poor prognosis. Radiotherapy side effects increase physiological and psychological stress in patients and their family members, causing fear of treatment, which may result in rejection or delay of treatment. This disease that could have been effectively controlled is thus delayed.

Treatment plan changes belong to device factors (group D). The initial preset causes include the radiation therapy machine (plan) change (e.g., linear accelerator to tomotherapy by asking the patient). However, several reasons should be considered, for example, good tumor response, body weight (body size) change, insufficient bladder expansion (e.g., changes in the location of prostate tumors), or even disease progression (e.g., changes in the location of lung tumors related to pleural effusion). Then, the physician assesses the needs and replan (adaptive plan). However, based on the initial research design, the fishbone

diagram analysis was used. This method has some known shortcomings. For instance, complex defects may have several causes, which may become visually confusing, and the relationship between the causes is not easy to identify. Thus, in the fishbone diagram, treatment plan changes belong to device factors (group D) and include tumor and mold factors and instrument change.

Moreover, the fishbone diagram analysis was used to examine the radiotherapy interruptions and non-completion rate from our department. We compiled the risk factors and prevention measures for treatment interruption, examined possible influencing factors and the effects of health education since 2016, and then provided early intervention and strengthened comorbidity assessment and consultation and nursing health education for self-care. In our department, fixed nursing care interventions accompany the whole treatment and posttreatment support at least once every 2 weeks. Nurses and nutritionists assess the nutritional status, and a follow-up booklet is used until body weight is stable.

Therefore, in our department, the patient numbers related to radiotherapy side effects decreased from 29.3% (68 in a total of 239 patients with interruptions) in 2016 and 14.8% (34 in a total of 150 patients with interruptions) in 2017 to 9% (22 in a total of 243 patients with interruptions) in 2018. The patient interruption and non-completion rates decreased from 30% (232 in a total of 764 patients treated) and 65% (150 in a total of 232 patients with interruptions) in 2016 and 28% (229 in a total of 817 patients treated) and 38% (87 in a total of 229 patients with interruptions) in 2017 to 26.8% (243 in a total of 907 patients treated) and 33% (80 in a total of 243 patients with interruptions) in 2018.

Conclusions

In this study, malnutrition, chemoradiotherapy side effects, and psychological and social support were found to be the most frequent interruption facts by the fishbone diagram analysis. Therefore, we focused on dietary health education, prevention of acute side effects, and strengthening of psychological and social support to decrease the treatment interruption rates in patients. A multidisciplinary team care model was established by using effective medical resources, controlling costs, and maintaining care quality to decrease the adverse effects caused by treatment interruption, thereby improving the quality of life and completion rate of patients. This can be used as a reference for nursing staff to

enhance radiotherapy nursing quality.

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Footnote

Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at <http://dx.doi.org/10.21037/tro-19-113>). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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