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REVIEW ARTICLE

The Review of the Studies on Exercise Programs for Cancer Patients

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ABSTRACT

Currently in South Korea, as long as the exercise is related with cancer, the exercise has been considered just as one of the useful life habits to prevent cancer and as an assisting method to endure the difficult treatment process of cancer with providing physical strength and strong will even in the clinic field. This study intended to provide the help for cancer prevention and treatment based on the review on the exercise programs for cancer patients that have been reported in the precedent studies; furthermore, it has been found that it is critical that the goal of exercise treatment according to the conditions of patients has to be determined in advance, in results of considering the precedent studies in order to contribute to raise the awareness of the role of exercise as the treatment method of cancer. Exercise program needs to be structured after determining the goals of exercise by considering the physical limitations that can be caused not only by cancer itself, but by the damages in the treatment process. For cancer patients, the goals of exercise need to be differentiated in each stage of treatment process; for the patients who are undergoing treatment, the goals of exercise become the maintenance of physical strength and emotional stability; and for those who completed anticancer treatment and got rid of cancer cells, the goals of exercise become the returning to ordinary life and the prevention from relapse. Before beginning the exercise program, it is significant to gather the information to secure the safety during exercising, to select the types of exercises that are customized for the patients and to establish exercise programs. Even though the exercise therapy methods that are specialized according to each cancer have not been established, it has been reported that exercise is closely related to the prevention from and treatment of cancer and it is considered that exercise therapy will be one of the important methods to treat cancer.

<Key words>
cancer, exercise prescription, exercise testing

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Ⅰ. Introduction

Among the numerous diseases, cancers are the most threatening and scary disease and also causes the serious inconvenience in daily living. The increase of life expectancy has also increased the incident rate of cancer. Cancers are the number one cause of death in South Korea; as for the cancer incidence rate, one out of three males and one out of four females get cancer; and the survival rate of five years from the lung cancer, which holds the first place among the causes of death due to cancers, is only 15.5%. Early medical checkup and the development of treatment methods, however, have led to heighten the survival rate of cancer patients; the five-year survival rate of thyroid cancer is 98.1% and that of breast cancer is 87.3% (Asan Cancer Center of Seoul Asan Medical Center, 2010).

In recent, even though a number of medical personnel have studied the treatment of and prevention from cancer and shown great progress and a number of non-medical personnel have tried to pay attention and to attain the specialized knowledge of the treatment of and prevention from cancer, cancers are still one of the most horrible diseases that threaten our health and life and have not been overcome.

In the U.S.A., the second place of the cause of death next to heart diseases is held by cancer; 25% of the dead died due to cancer. A number of researchers, however, have reported that most of cancers can be prevented by changing life habits simply; smoking accounts for the 30% of the dead due to cancers and obesity that is deeply related with exercise and diet does for another 30% of the dead due to cancers (Thomas et al, 2011).

The cell that is the smallest part of body is normally divided and grows through the control functions of cell itself and the balance of its number is kept by killing itself when its lifespan is about to be done or it is damaged. When the control function of cell itself has been damaged due to diverse reasons, however, the cells that should have been destroyed get to excessively multiply, sometimes form tumors by breaking into tissues and organs and destroy or transform the existing structure; this state is called as cancer (Seungmin Yu, 2013). That is, it can be said that cancer is not a disease, but the complex of numerous diseases with the traits of excessive multiplication or uncontrollableness and those excessively multiplied or uncontrolled cells are spread to other organs. Surgery, radiation, chemotherapy and immunotherapy are generally applied to treat cancers separately or together. To treat cancer, the elimination of cancer cells, control of illness and alleviation of symptoms can be used. Cancer treatment aims to get rid of cancer cells and it is considered to be completed when relapse has not occur (Schwartz, 2000).

Practically all the cancer patients can get help from rehabilitation and exercise. The goals of exercise therapy can be differentiated according to the state of patients, for example, when patients are diagnosed, when cancer cells are eliminated, or when patients are undergoing anticancer treatment. How patients respond to exercise or how much they adjust to it can be different according to which parts or organs of body have cancer cells. Therefore, the roles and application of exercise therapy in the cancer

treatment process need to be extremely individualized for each cancer patient. In this context, the exercise program for cancer patients needs to be provided with the very individualized form by clinical exercise professionals.

Currently in South Korea, as long as the exercise is related with cancer, the exercise has been considered just as one of the proper life habits to prevent cancer and as an assisting method to endure the difficult treatment process of cancer with providing strength and strong will even in the clinic field. Recent studies, however, have presented continually that exercises plays significant roles for preventing from contracting certain cancers including breast cancer, colorectal cancer, etc. and for the rehabilitation after treatment. It is expected that the increase of the level of immunity through exercise will be directly of great help to prevent from and treat cancer. The studies on how exercise directly affect the cancer treatment, however, have stayed in the preliminary stage and the application of exercise therapy for cancer patients has been done very limitedly. Therefore, this study intended to help cancer prevention and treatment based on the review on the exercise programs for cancer patients that have been reported in the precedent studies and to raise the awareness of the role of exercise as the treatment method of cancer.

Ⅱ. Body

1. The Effects to Affect the Physical Activities of Cancer Patients

Cancer treatment process leads to a great deal of the decrease of quality of life including depression, anxiety, stress, body image concerns, sleep disorder, decreased self-esteem and loss of a control(Courneya, 2001: Courneya et al, 2000). Cancers are related with the physical symptoms and changes such as weakness and debility, decreased ability of controlling muscle movement, decreases of weight, muscle mass and cardiovascular endurance, deep fatigue, nausea, vomiting and pain; 40~100% of Cancer patients experience fatigue in the treatment process, which is the most critical symptom to affect their quality of life (Courneya et al, 2000). These symptoms are presented most seriously during treatment, but they may sometimes last a few months or years even after treatment.

Cancer patients or patients who are receiving anticancer treatment after cancer treatments may experience physical limitations and those limitations also may affect ordinary physical activities including exercise. Tumors may grow at any part of body and directly affect cells (Schwartz, 2000).

The side effects of anticancer treatments also have an influence on exercise response. The side effects of anticancer treatments may appear as shown in Table 3, and they may become chronic.

Table 1. Disease/Treatment-specific Physical Limitations

The parts of body	Limitations
Musculoskeletal system	Pain
Lung	Shortness of breath
Central nervous system/brain	Neural deficits, seizures
Bone marrow	Anemia
Advanced cancer	Easy fatigability

Table 2. Side Effects of Anticancer Therapy on the Exercise Response

Type of Anticancer Therapy	Side Effects (permanent)
· Amputation	· Permanent disability
· Radiation / chemotherapy	· Permanent scar formation in joints, lung and heart tissues
· Drug-induced cardiomyopathy / anemia	· Permanent limitation on cardiovascular function

Table 3. Acute and Chronic Treatment Effects

Treatment	Acute Effects	Chronic Effects
Surgery	Pain, fatigue, limited ROM(range of motion)	Pain, loss of flexibility, Nerve damage
Radiation	Pain, fatigue, skin irritation, pulmonary inflammation	Nerve damage, cardiac and/or lung scarring, fractures
Chemotherapy	Fatigue, nausea, anemia, nerve damage, muscle pain, weight gain	Cardiomyopathy, lung scarring, nerve damage, fatigue, bone loss, leukemia
Immunotherapy	Weight gain or loss, fatigue, flu-like syndrome, nerve damage	Nerve damage, myopathy

Source : J. Larry Durstine, Geoffrey E. Moore(2003). ACSM'S Exercise Management for Persons with Chronic Diseases and Disabilities.

2. Effects of Exercise Training on Cancer Patients

Exercise may be safe and of help to treat cancer, if it is prescribed according to the individual conditions. That is, the goals of exercise program for the patients may be subject to be changed according to the conditions of patients. The exercise therapy for patients who are undergoing anticancer treatments aims to maintain endurance, strength and level of function and to overcome psychological symptoms of depression and that for those who finished anticancer treatments does to return them to their former level of physical and physiological function (Schwartz, 2000).

Table 4. Benefits of Regular, Moderate-intensity Aerobic and Resistance Exercise during Cancer Therapy

· Reduced levels of fatigue
· Greater body satisfaction
· Maintenance of body weight
· Improved mood
· Less side effect severity
· A higher quality of life
· Improve bone remodeling
· Reduce muscle weakness
· Reduce the muscle-wasting effects of glucocorticoids

Exercise training deeply affects the functional ability of daily activities. It has been reported that the functional ability of the patients who participated in aerobic exercise program has significantly increased through the 12-minute walk test; in the meantime, the patients who refused to participate in the program showed the over-25-percent decrease of functional ability after 8 weeks. Even for the patients who are undergoing intense anticancer treatment, low-to-moderate intensity exercise, physical therapy and occupational therapy may be of help. Even when patients who are undergoing anticancer treatment are experiencing severe fatigue, exercise has decreased fatigue and improved functional ability, mood and quality of life (Durstine and Moore,2003). The studies on the effects of exercise for patients with breast cancer have been well conducted until now and the treatment results of patients with breast cancer who had participated in exercise program are shown in Table 5.

Table 5. The Benefits of Exercise Training on Women who Have Breast Cancer

· Improved shoulder range of motion
· Reduced fatigue, nausea, and other treatment-related side effects
· Improved functional ability
· Improved ability to maintain body weight
· Enhanced self-image / sense of control
· Increased muscle mass in women receiving postoperative chemotherapy
· Improved mood and quality of life

Source : J. Larry Durstine, Geoffrey E. Moore(2003). ACSM'S Exercise Management for Persons with Chronic Diseases and Disabilities.

3. Recommendations for Exercise Testing of Cancer Patient.

Preliminary examinations of coronary artery disease and cancer-related problems of cancer patients need to be conducted before exercise program. Cancer patients generally show the same incidence rate of coronary artery diseases with persons without cancers. ACSM(American College of Sports Medicine) recommended exercise testing to persons who are males of 40 and older, females of 50 and older and have more than two risk factors before starting exercise program (ACSM, 1986).

The regular exercise for patients who completed anticancer treatment is critical to maintain or improve the ability of performing the activities of daily living and to prevent the incidence of diseases that may be caused by the lack of physical activity. Formal exercise testing needs to be conducted as the individual program based on the consideration of the types of patients' diseases, the types of treatment and physical limitations (Durstine and Moore, 2003).

The interaction with patients is required during the implementation of exercise program or exercise testing for cancer patients and clinical exercise professionals are required to be qualified with two conditions. First, clinical exercise professionals have to study the treatments that patients have been undergoing. When clinical exercise professionals are not familiar with the type of cancer of patients, they need to study about it and to gather the information on the patients through the discussion with the doctors who have conducted his or her treatment or surgery for the individualized exercise testing and exercise therapy; these process will maximize the effects of exercise and minimize its side effects. Second, clinical exercise professionals need to develop questioning method and questioning skill to effectively monitor how well patients endure the diseases and treatment process. These skills can be developed through the clinical

experiences and will improve the ability to evaluate the interaction of exercise, cancer and exercise therapy.

Clinical exercise professional need to pay attention to the clinical conditions that may be caused by sudden exercise and last for a few days or one week or over including difficulty in breathing during exercise, the increase of anxiety or depression that was caused by sleep disturbance or the avoidance of social contact and the sudden change of nutritive conditions. To identify these conditions, exercise specialists need to assess exercise compliance and progress by regularly making follow-up phone calls or letting patients visiting clinics (Jonathan, Paul M, Paul S, & Steven, 2003).

Before cancer patients start exercise program, medical history check and physical examination need to be conducted; medical history check is conducted based on both non-cancer and cancer considerations.

Table 6. The Items of Medical History Check before Exercise Testing of Cancer Patients

Non-cancer Considerations	Cancer Issues
· Age · Diabetes · Hypertension · Fitness level · Orthopedic problems	· Type and stage of cancer · Type of treatment · Side effects of therapy · Psychological status · Timing of tests and therapy

Physical checkup needs to be conducted to identify acute symptoms or signs to prohibit from exercise. Acute symptoms and signs to prohibit from exercise include bone tenderness by metastatic lesions, secondary walking difficulty by neuropathy due to the chemotherapy or the damage of central nervous system and complications due to the treatment of wound, immune suppression or bleeding.

There are unique things that cancer patients need to consider in conducting exercise testing including the matters that non-cancer patients have to pay attention.

Table 7. Contra-indications to Exercise for Cancer Patients

· Hemoglobin < 10.0 g·dL^{-1}
· White blood cells < 3,000 · $\mu\ell^{-1}$
· Neutrophil count<0.5× 10^{9}㎖$^{-1}$
· Platelet count<50× 10^{9}㎖$^{-1}$
· Fever > 38℃
· Unsteady gait(ataxia)
· Cachexia or loss of >35% of premorbid weight
· Limiting dyspnea with exertion
· Bone pain
· Severe nausea

Source : Jonathan K. Ehrman, Paul M. Gordon, Paul S. Visich, Steven J. Keteyian. Clinical Exercise Physiology.

Table 8. Summary of Exercise Testing for Cancer Patients

Method	Measure	Endpoints	Comments
Aerobic Cycle treadmill	· 12-lead ECG, HR · BP, RPP · RPE(6-20)	· O_2peak/work rate · Serious dysrhythmias · >2mm ST-segment depression or elevation · T-wave inversion · SBP>250 mmHg or DBP>115 mmHg	
Endurance 6 to 12-min walk	· Distance covered	· volitional fatigue	· Endurance often limited.
Strength Isotonic/isokinetic	· 1 RM · 3 RM	· Maximum voluntary contraction · Maximum number of reps · Peak torque	· Atrophy and frailty common.
Flexibility Goniometry sit and reach		· Angle of flexion/extension · Distance	· Assess upper-extremity range of motion after mastectomy · Atrophy can limit range of motion.
Functional capacity Gait analysis			· Assess for neuropathy after vincristine or radiation

Source : J. Larry Durstine, Geoffrey E. Moore(2003). ACSM'S Exercise Management for Persons with Chronic Diseases and Disabilities.

Exercise testing for cancer patients as shown in the Table 8 is proper for general cancer patients. For the patients with the presence of comorbidities, however, specific disease-related symptoms, or treatment-related side effects, the testing needs to be modified as follows:

Cancer and cancer therapy have the potential to affect the health-related components of physical fitness (i.e., cardiovascular fitness, muscular strength and endurance, body composition, flexibility, and gait and balance). Ideally, cancer patients should receive a

comprehensive fitness assessment involving all components of health-related fitness.

· A thorough screening for cancer comorbidities and exercise contraindications should take place before exercise testing, including a medical history, physical examination, and laboratory tests, such as a complete blood count, lipid profile, and pulmonary function test.

· Medical supervision of symptom-limited or maximal exercise testing is strongly recommended.

· Decisions regarding testing protocols may be influenced by the specific disease or treatment-related limitations of the individual.

· Decisions regarding testing modes may be influenced by the specific disease or treatment-related limitations of the individual(ACSM, 2010).

4. Recommendations for Exercise Programming of Cancer Patient.

The exercise program for cancer patients can be subject to be changed according to their conditions; the design of exercise program is required to be differentiated according to the state of patients, for example, when patients are undergoing anticancer treatment, when cancer cells are eliminated or when patients are undergoing retreatment due to relapse or metastasis. The goals of exercise programs for the patients who are undergoing treatment become the maintenance of physical strength and, if possible, the improvement of functions. For the survivors who has fully recovered from cancer, their goals of exercise become to return to healthy and active life and to make exercise an indispensable factor in their daily life. For the patients who are experiencing relapse or metastasis, the goals of exercise become customized to the level of function of patients. For the patients who have struggled against metastatic cancer, the goals of exercise become the mobility and the independent life at home. Because many cancer patients have the exercise limitations due to cancer or cancer treatment, the types and methods of exercise need to be customized according to those limitations when constructing exercise programs (Durstine et al, 2003). The proper frequency, duration and time course to adjust to exercise have not been fully investigated yet. According to the reports on the correlation between fatigue and exercise, the patients with the exercise of over-10-minutes duration feel less fatigue; the frequency of exercise needs to be done at least every other day to feel less fatigue (Mock et al, 1997).

Side effects of anticancer treatment may appear acutely or be delayed. Therefore, the goals and themes of exercise programs need to be clearly differentiated according to

whether the patients are undergoing cancer treatment or completed it. That is to say, the clinic exercise professionals need to consider that patients are undergoing treatment or are resting because of high fatigability and which stage the patients are in. Because most of cancer patients get treated by combining surgery, radiation, chemotherapy and immunotherapy, exercise specialists(or clinic exercise professionals) have the great possibility to confront the combination of problems that are related to each type of treatment.

Table 9. Summary of Exercise Programming for cancer patients

Modes	Goals	Intensity / Frequency / Duration
Aerobic · Large muscle activities (walking, rowing, cycling, water aerobics)	· Improve/maintain work capacity · Control body weight · Improve mood · Reduce fatigue · Improve quality of life	· Symptoms limited ; moderate intensity · Exercise at least every other day · 15-40min/session
Strength · Free weights · Weight machines · Isokinetic machines · Therabands · Circuit training	· Maintain or improve strength in arms, legs, and trunk · Increase maximal voluntary contraction, peak torque, and power	· Symptom-limited intensity · 50% of 1RM · 2-3day/wk for 20-30min · 2-3 sets of 3-5 reps, building to 10-12 reps
Flexibility · Stretching	· Increase /maintain ROM · Decrease stiffness from disuse	· 5-7 days/wk.
Functional · ADLs · Gait and balance exercise	· Maintain as much independence as possible · Increase daily living activities. · Return to work · Improve gait · Improve balance	· Daily

Source : J. Larry Durstine, Geoffrey E. Moore(2003). ACSM'S Exercise Management for Persons with Chronic Diseases and Disabilities.

Table 10. General Aerobic Exercise Recommendations for Otherwise Healthy Cancer Survivors

Parameter	Guidelines and comments
Mode	Most exercises involving large muscle groups are appropriate, but walking and cycling are especially recommended. The key is to modify exercise mode based on acute or chronic treatment effects from surgery, chemotherapy, or radiation therapy.
Frequency	At least three to five times per week, but daily exercise may be optimal for deconditioned survivors performing lighter intensity or shorter duration exercises.
Intensity	Moderate intensity depending on current fitness level and severity of side effects from treatments. Guidelines include 50% to 75% $VO_{2\ max}$ or $HR_{reserve}$, 60% to 80% HR_{max}, or 11 to 14 RPE. $HR_{reserve}$ is best guideline if HR_{max} is estimated rather than measured.
Duration	From 20 to 60 continuous minutes, but this goal may have to be achieved through multiple intermittent shorter bouts (e.g.,5 to 10 minutes) with rest intervals in deconditioned survivors or those experiencing severe side effects of treatment.
Progression	Initial progression should be in frequency and duration, and intensity be increased only when these goals are met should. Progression should be slower and more gradual for deconditioned survivors and those experiencing severe side effects of treatment.

Source : David C. Nienman (2003). Exercise Testing and Prescription. Mc Graw Hill.

Ⅲ. Conclusion

Currently in South Korea, as long as the exercise is related with cancer, the exercise has been considered just as one of the proper life habits to prevent cancer and as an assisting method to endure the difficult treatment process of cancer with providing strength and strong will even in the clinic field. Recent studies, however, have presented continually that exercises plays significant roles for preventing from contracting certain cancers including breast cancer, colorectal cancer, etc. and for the rehabilitation after treatment. It is expected that the increase of the level of immunity through exercise will

be directly of great help to prevent from and treat cancer. Therefore, this study intended to help cancer prevention and treatment based on the review on the exercise programs for cancer patients that have been reported in the precedent studies and to raise the awareness of the role of exercise as the treatment method of cancer. Furthermore, it has been found that it is critical that the goal of exercise treatment according to the conditions of patients has to be determined in advance, in results of considering the precedent studies in order to contribute to raise the awareness of the role of exercise as the treatment method of cancer. Exercise program needs to be structured after determining the goals of exercise by considering the physical limitations that can be caused not only by cancer itself, but by the damages in the treatment process. For cancer patients, the goals of exercise need to be differentiated in each stage of treatment process; for the patients who are undergoing treatment, the goals of exercise become the maintenance of physical strength and emotional stability; and for those who completed anticancer treatment and got rid of cancer cells, the goals of exercise become the returning to ordinary life and the prevention from relapse. Before beginning the exercise program, it is significant to gather the information to secure the safety during exercising, to select the types of exercises that are customized for the patients and to establish exercise programs. Even though the exercise therapy methods that are specialized according to each cancer have not been established, it has been reported that exercise is closely related to the prevention from and treatment of cancer and it is considered that exercise therapy will be one of the important methods to treat cancer.

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