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Correlation with cognitive function and chemotherapy in breast cancer: preliminary study

Na Ri Yun^{1*}, Ji Hee Kim^{1†}

Wonkwang University School of Medicine, Department of Rehabilitation Medicine¹

Objectives

To investigate the effect of chemotherapy on cognitive function, cardiorespiratory fitness and physical activity in breast cancer patient.

Methods

From June 2017 to April 2018, patients between the ages of 40-70 who underwent surgery due to breast cancer in the department of the breast and thyroid surgery were enrolled. A total 10 patients were recruited and divided into two groups. Patients treated with chemotherapy are chemotherapy group (n=5), and patients who did not receive chemotherapy are non-chemotherapy group (n=5). Age, types of breast cancer surgery, history of chemotherapy and radiotherapy, education level, Korean version of the Mini-Mental State Exam (K-MMSE), Beck depression inventory (BDI) were collected as demographic data. In addition, we performed the Korean version of Montreal cognitive assessment (MOCA-K), Computerized Neuro-cognitive Function Test (CNT) for cognitive function evaluation and evaluated the International Physical Activity Questionnaire (IPAQ) to measure physical activity level. We also performed cardiopulmonary exercise test using modified Bruce protocol to evaluate cardiorespiratory fitness. All outcomes were measured after surgery (T0, baseline) and immediately after the anti-cancer therapy (T1).

Results

Among the chemotherapy group, the mean age was 56.2 ± 8.1 , and 48.8 ± 4.3 in the non-chemotherapy group. In chemotherapy group, breast cancer stage 2 and 3 were more frequent, and mastectomy was performed more frequently. Education level, K-MMSE, BDI scores did not showed significant differences between two groups (Table 1). No significant differences were found between two groups in the cognitive function outcomes at T0. There was also no significant change in cognitive function outcomes between T0 and T1 in both groups when compared within each group. In IPAQ, there was no significant difference between the two groups, but the ratio of Category 2 at T1 was increased in both groups (Table 2). Similarly, there was no significant difference between the two groups in the cardiorespiratory fitness parameters at T0. However, anaerobic threshold (AT) was significantly lower in the chemotherapy group than in the non-chemotherapy group at T1 (18.38 and 24.66 respectively, $p < 0.05$) (Table 3).

Conclusions

Chemotherapy did not significantly affect cognitive function, cardiorespiratory fitness, and physical activity at the time immediately after chemotherapy in breast cancer

patients. However, further evaluation of the effect of chemotherapy on these parameters over time will be needed in future through a long-term follow up evaluation.

Table 1. Baseline characteristics of the subjects.

Parameters	Chemotherapy group (n=5)	Non-chemotherapy group (n=5)	p-value
Age (year)	56.2 ± 8.1	48.8 ± 4.3	0.095
Breast cancer stage			
I	0 (0)	5 (100)	0.008*
II	3 (60)	0 (0)	
III	2 (40)	0 (0)	
Surgery type			
Breast-conserving surgery+radiotherapy	1 (20)	5 (100)	0.048*
Mastectomy	4 (80)	0 (0)	
Neoadjuvant chemotherapy only	0 (0)	0 (0)	
Chemotherapy			
TC	2 (40)	N/A	
AC	0 (0)		
TC+AC	3 (60)		
Radiotherapy	3 (60)	5 (100)	0.444
Education level			
Elementary school	1 (20)	0 (0)	0.357
Middle school	0 (0)	3 (60)	
High school	2 (40)	1 (20)	
University	2 (40)	1 (20)	
K-MMSE	28.0 ± 1.2	28.0 ± 0.8	0.421
BDI	11.4 ± 5.3	13.4 ± 10.1	0.841

Values are presented as mean ± standard deviation or number (%).

TC, Doxitaxel, cyclophosphamide; AC, Doxorubicin, cyclophosphamide; K-MMSE, Korean version of the Mini-Mental State Exam; BDI, Beck Depression Inventory.

* $p < 0.05$

Table 2. Comparison of cognitive function, physical activity between two groups at baseline, post anti-cancer therapy

Variables	Group	T0	T1	<i>p</i> -value
K-MMSE	Chemotherapy	28.00 ± 1.22	28.4 ± 1.1	0.310
	Non-chemotherapy	28.80 ± 0.84	29.2 ± 0.8	
MOCA-K	Chemotherapy	25.60 ± 2.97	26.8 ± 2.4	0.841
	Non-chemotherapy	25.80 ± 2.77	27.2 ± 0.4	
CNT-D	Chemotherapy	45.90 ± 18.70	46.7 ± 18.6	1.000
	Non-chemotherapy	47.30 ± 18.09	47.7 ± 17.5	
CNT-V	Chemotherapy	37.50 ± 6.89	40.3 ± 6.7	0.548
	Non-chemotherapy	44.90 ± 5.99	42.6 ± 7.8	
CNT-T	Chemotherapy	39.00 ± 8.85	42.1 ± 10.4	0.690
	Non-chemotherapy	39.60 ± 8.60	40.4 ± 8.1	
CNT-W	Chemotherapy	36.88 ± 7.61	36.7 ± 6.5	0.690
	Non-chemotherapy	40.04 ± 10.75	40.0 ± 9.9	
BDI	Chemotherapy	11.40 ± 5.32	8.8 ± 4.8	0.095
	Non-chemotherapy	13.40 ± 10.14	13.4 ± 2.5	
IPAQ (Continuous score)	Chemotherapy	481.80 ± 336.21	863.00 ± 470.40	0.310
	Non-chemotherapy	431.80 ± 316.72	647.70 ± 505.34	
IPAQ (Categorical score)	Chemotherapy	C1	3 (60)	1.000
		C2	2 (40)	
	Non-chemotherapy	C1	4 (80)	1.000
		C2	1 (20)	

Values are presented as mean ± standard deviation or number (%).

K-MMSE, Korean version of the Mini-Mental State Exam; MOCA-K, Korean version of Montreal cognitive assessment; CNT-D, Computerized Neuro-cognitive Function Test-Digit span; CNT-V, Computerized Neuro-cognitive Function Test-Visual span; CNT-T, Computerized Neuro-cognitive Function Test-Trail making; CNT-W, Computerized Neuro-cognitive Function Test-Word color test; BDI, Beck Depression Inventory; IPAQ, International Physical Activity Questionnaire; C1, Category 1; C2, Category 2.

**p*<0.05

Table 3. Comparison of cardiorespiratory fitness between the two groups at baseline, post anti-cancer therapy

Variables	Group	T0	T1	<i>p</i> -value
VO ₂ max (ml/kg/min)	Chemotherapy	22.36 ± 4.55	21.54 ± 2.06	0.222
	Non-chemotherapy	27.80 ± 2.96	26.98 ± 5.50	
METs	Chemotherapy	6.40 ± 1.32	6.14 ± 0.59	0.222
	Non-chemotherapy	7.94 ± 0.85	7.70 ± 1.58	
RER	Chemotherapy	1.35 ± 0.17	1.37 ± 0.14	0.151
	Non-chemotherapy	1.33 ± 0.13	1.24 ± 0.15	
VE _{max} (L/min)	Chemotherapy	52.51 ± 11.88	48.50 ± 7.02	0.421
	Non-chemotherapy	49.74 ± 7.90	43.32 ± 8.93	
AT (ml/kg/min)	Chemotherapy	18.82 ± 2.98	18.38 ± 2.91	0.032*
	Non-chemotherapy	23.88 ± 4.85	24.66 ± 4.31	

VO₂max, maximal oxygen consumption; METs, Metabolic equivalent tasks; RER, Respiratory exchange ratio; VE_{max}, Maximal pulmonary Ventilation; AT, Anaerobic Threshold.

**p*<0.05