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Survival and Compliance with the Use of Radiation Therapy for Anaplastic Thyroid Carcinoma

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Purpose: The purpose of this study was to evaluate the impact of the use of external radiation therapy (ERT) in terms of survival and compliance in patients with anaplastic thyroid carcinoma.

Materials and Methods: The medical records of 17 patients with anaplastic thyroid carcinoma treated with ERT between 1993 and 2002 were retrospectively reviewed. ERT was administered after surgery in 14 patients and after a biopsy in three patients. Among the 14 patients who had undergone surgery, nine underwent a curative resection and five underwent a palliative resection. Six patients had associated well-differentiated thyroid carcinomas and 14 patients were diagnosed with a tumor size exceeding 5 cm. The radiation dose ranged from 6~70 Gy (median dose, 37.5 Gy). Eleven patients completed the planned course of ERT, whereas six patients did not. The follow-up period ranged from 1~104 months (median, 5 months; mean, 20 months).

Results: Five patients started the ERT without the presence of a gross mass and all of the patients completed ERT without a re-growth of tumor. Twelve patients (four patients after a curative resection, five patients after a palliative resection and three patients after a biopsy) started ERT with a gross mass present and only six patients were able to complete the planned course of ERT. Among the six patients who completed ERT, two patients showed a marked regression of the tumor mass, whereas two patients showed slight regression and two patients showed no response. The median survival was five months (range, 1~104 months) and the mean survival was 21 months. The overall survival was 41% at 1-year, 24% at 2-years and 12% at 5-years. Significant prognostic factors included the number of primary tumors present, tumor size, whether surgery was performed and completion of ERT as planned. Long-term survivors showed a tendency of having smaller sized initial tumors and smaller sized pre-ERT tumors than the short-term survivors.

Conclusion: This study suggests that patients with a small initial tumor (≤5 cm), which was treated by surgery (curative resection or palliative resection) before ERT, and without rapid re-growth of the mass seen at the surgical site at the beginning of the ERT course, would be the best candidates for postoperative ERT. In contrast, patients with a large initial tumor (>5 cm) and did not undergo surgery before ERT or that rapid re-growth of the mass was observed at the surgical site are likely to have a short survival time, along with the interruption of ERT. In these cases, the role of ERT is very limited and the omission of ERT could be considered.

Key Words: Anaplastic thyroid carcinoma, External radiation therapy, Compliance

Introduction

Anaplastic thyroid carcinoma has a very poor prognosis, with a median survival of four to 12 months after diagnosis.[1~4] Although a poor prognosis is generally accepted, there are different opinions regarding treatment options. Due to the rarity of an anaplastic thyroid carcinoma, it is difficult to study prospectively or to establish a randomized trial about the effectiveness of various treatment methods. Controversy exists regarding the benefit of the use of external radiation therapy (ERT) in patients with anaplastic thyroid carcinoma. Although some studies have been unable to demonstrate any benefit, other studies have reported a benefit with the use of

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ERT and chemotherapy.[5~8)]

In our hospitals, surgeons usually refer patients with anaplastic thyroid carcinoma for ERT after surgery or a biopsy. Sometimes the decision to begin ERT or not is very difficult due to the presence of dyspnea from a huge mass and the rapidly progressive nature of the disease. Therefore, a prediction about compliance with ERT and prognosis of the patient is helpful in the decision making process to use ERT.

In this study, we investigated the impact of the use of external radiation therapy (ERT) in terms of feasibility and survival in patients with anaplastic thyroid carcinoma. We also compared the characteristics of patients that survived for more than one year (long-term survivors) with the characteristics of patients that survived for three months or less (short-term survivors) to determine the clinical characteristics of patients that would receive a benefit from the use of ERT.

Materials and Methods

The medical records of patients treated by ERT for anaplastic thyroid carcinoma at the Department of Radiation Oncology of Chonnam National University Hospital and Chosun University Hospital between 1993 and 2002 were retrospectively reviewed. Seventeen patients were treated with ERT during this period (Table 1). The median patient age was 66 years (age range, 47~81 years). There were 12 (71%) females and 5 (29%) males. The original pathological diagnosis, the method for acquisition of the pathological diagnosis (fine needle aspiration biopsy or surgery), the association of a well-differentiated thyroid carcinoma with an anaplastic carcinoma, the presence of other primary tumors, the size of the tumor and the method of surgery were reviewed. Records about the status of tumor at the start of ERT, the fractionation schedule, total ERT dose and patient status during ERT were also reviewed.

Six patients had an associated well-differentiated thyroid carcinoma, and 14 patients were seen with a large tumor size of more than 5 cm at diagnosis. Of the 17 patients, postoperative adjuvant ERT was administered after surgery in 14 patients and palliative ERT after a biopsy in three patients. Among the 14 patients who had undergone surgery, nine patients underwent a curative resection and five patients underwent a palliative resection. Four (44%) of the nine patients who underwent a curative resection showed rapid re-growth of the mass at the surgical site and received ERT with a gross mass present. Therefore, only five patients did not show any gross mass at the time of starting ERT.

Table 1. The Characteristics of Patients and Treatment

		No. of patients
Age (years)	Range 47~81	Median=66
	<60	5
	≥60	12
Gender	Male	5
	Female	12
WDTC*	Yes	6
	No	11
First malignancy	Yes	14
	No	3
Number of primary tumor	One	15
	Two	2
Tumor size	≤5 cm	3
	>5 cm	14
Surgery	Yes	14
	No	3
Resection	Curative	9
	Palliative	5
	Biopsy only	3
Gross mass at ERT† start	No	5
	Yes	12
Complete ERT	Yes	11
	No	6
ERT intent	Curative	8
	Palliative	9

*associated with a well-differentiated thyroid carcinoma, †ERT: external radiation therapy

To investigate the characteristics of the patients where the ERT course was interrupted and to obtain indication criteria for ERT, all patients were included in this study. The radiation treatment dose ranged from 6~70 Gy (median dose, 37.5 Gy). Conventional ERT was administered and 6 MV X-ray or 9 MeV electron beam from a linear accelerator was used.

The treatment results were analyzed as the mean survival, the median survival, 1-year survival, 2-year survival and 5-year survival. Local control of a tumor mass was described as marked regression and slight regression instead of complete remission and partial remission, as in some patients the precise measurement of tumor size was impossible due to a diffuse infiltration in the neck. The baseline of follow up for overall survival was the day of surgery in operated patients and the biopsy day in the patients who did not undergo

surgery. The follow-up period ranged from 1~104 months (median, 5 months; mean, 20 months). Overall survival was calculated using the Kaplan-Meier method and the log rank test was used for comparing differences between two groups. Multivariate analysis using Cox regression analysis was also performed for various prognostic factors. Statistical analysis was performed with the Statistical Package for Social Sciences 12.0 software (SPSS, Chicago, IL, USA).

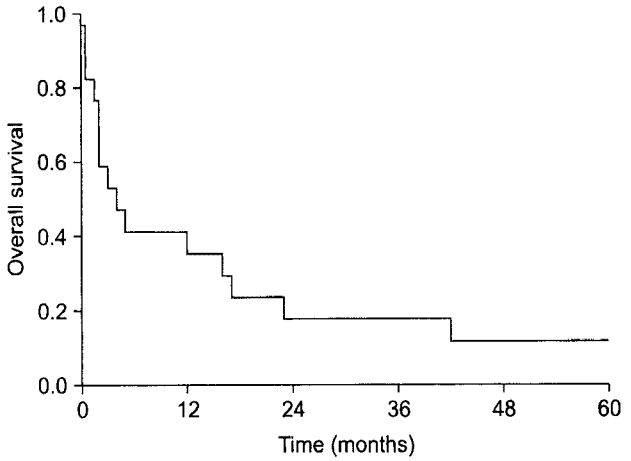

Fig. 1. The overall survival of 17 patients of anaplastic thyroid carcinoma treated by radiation therapy is shown.

Results

1. Interruption of ERT in patients due to poor tolerance

Eleven patients completed the planned course of ERT (curative or palliative) and six of the 17 patients (35%) did not complete either a curative or a palliative ERT course. Among the six interrupted patients, three patients received ERT after a curative resection and rapid re-growth of the tumor and three patients received ERT after a biopsy. ERT was interrupted due to poor tolerance such as the occurrence of severe dyspnea. All interrupted patients survived for three months or less, except for one patient who survived for 13 months. All patients were treated with a palliative intent. All

Table 2. Analysis of the Prognostic Factors for Anaplastic Thyroid Carcinoma

Variable		No of patients	Mean survival (months)	Median survival (months)	p-value	
					Univariate	Multivariate
Age	<60 years	5	46.8±21.0	19	0.0957	
	≥60 years	12	10.3±3.8	3		
Gender	Male	5	18.2±14.5	2	0.6055	
	Female	12	20.4±8.1	6		
WDTC*	Yes	6	19.3±11.9	3	0.9443	
	No	11	20.0±8.9	6		
First malignancy	Yes	14	23.8±9.3	5	0.3328	
	No	3	8.0±6.5	2		
Number of primary tumors	One	15	23.6±8.7	6	0.0167	
	Two	2	1.5±0.5	1		
Tumor size	≤5 cm	3	57.3±19.6	44	0.0431	0.159
	>5 cm	14	11.7±5.6	3		
Surgery	Yes	14	25.2±9.1	6	0.0010	0.029
	No	3	1.3±0.3	1		
Resection extent	Curative	9	23.2±10.5	6	0.0046	
	Palliative	5	24.6±13.4	13		
	Biopsy only	3	1.3±0.3	1		
Gross mass at ERT†start	No	5	39.4±15.4	24	0.0623	
	Yes	12	11.6±6.4	3		
Complete ERT	Yes	11	30.5±11.0	19	0.0033	0.041
	No	6	3.5±1.9	1		
ERT intent	Curative	8	28.4±11.0	19	0.0824	
	Palliative	9	12.1±8.4	2		

*associated with a well-differentiated thyroid carcinoma, †ERT: external radiation therapy

patients had an initial tumor larger than 5 cm and the presence of a gross mass at the time of ERT commencement.

2. Overall survival and prognostic factors and local control

The median survival was five months (range, 1~104 months) and the mean survival was 21 months. The overall survival was 41% at 1-year, 24% at 2-years and 12% at 5-years (Fig. 1). The prognostic variables evaluated for univariate analysis included age (<60 years or ≥60 years), gender (male, female), coexistence of a well-differentiated thyroid carcinoma (yes or no), a first malignancy (yes or no), the number of primary tumors (one or two), tumor size (≤5 cm or >5 cm), surgery (yes or no), resection extent (curative resection, palliative resection, biopsy only), the presence of a gross mass at the start of ERT (yes or no), completion of ERT (yes or no) and ERT intent (curative or palliative). Univariate analysis of the prognostic variables for overall survival is shown in Table 2. The number of primary tumors (p=0.0167), tumor size (p=0.0431), surgery (p=0.0010), resection extent (p=0.0046) and completion of ERT as planned (p=0.0033) were statistically significant factors. The overall survival curves according to tumor size, surgery and completion of ERT as planned are shown in Fig. 2. The variables included in multivariate analysis were tumor size, surgery and completion of ERT as planned (Table 2). Based on this analysis, surgery (p=0.029) and completion of ERT as planned (p=0.041) were statistically significant.

Among the nine patients that underwent a curative resection, five patients started ERT without the presence of a gross mass and all of the patients could complete ERT without re-growth of the tumor. Four patients were seen with a rapid re-growth of the tumor mass even after curative resection. A total of 12 patients (four patients after curative

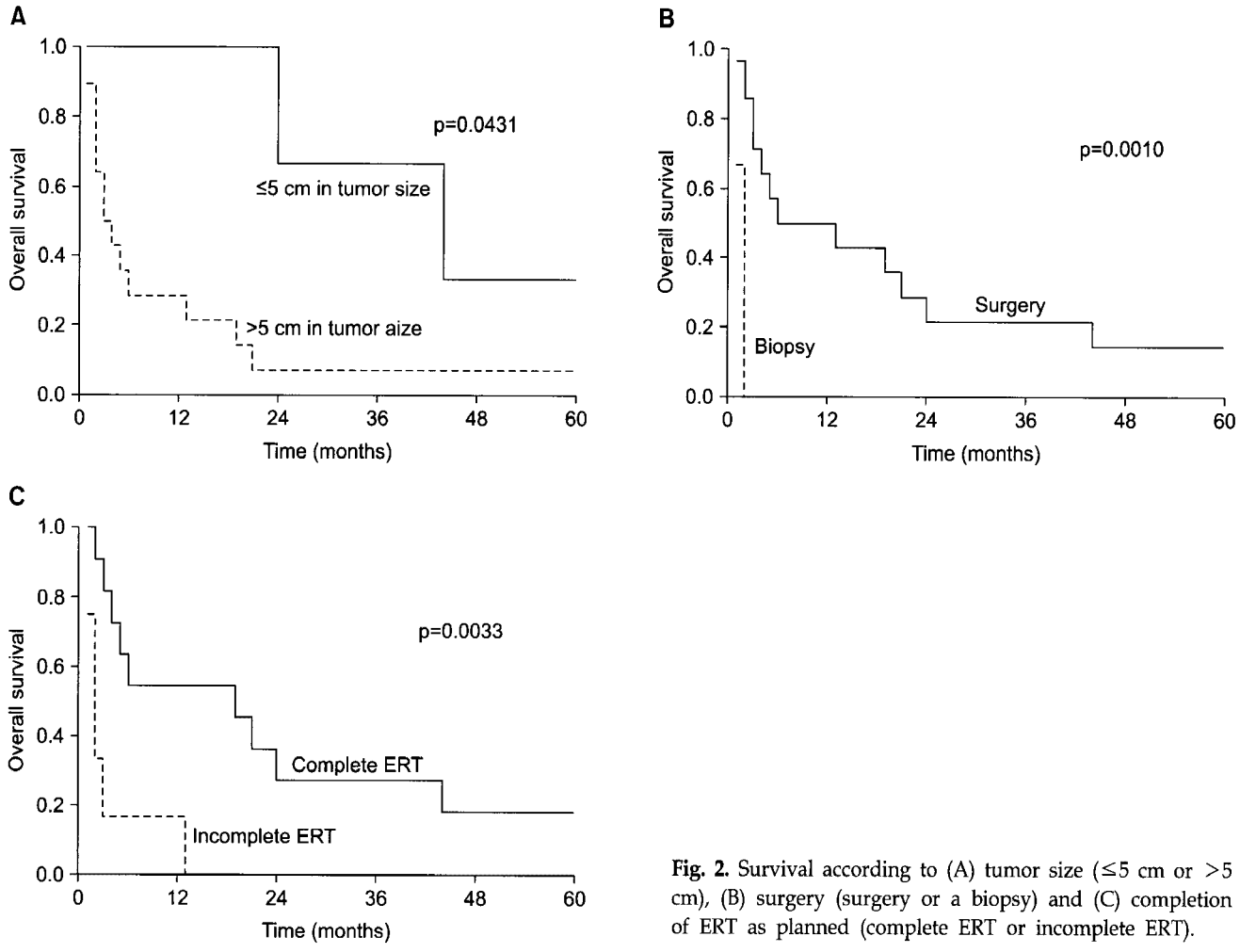

Fig. 2. Survival according to (A) tumor size (≤5 cm or >5 cm), (B) surgery (surgery or a biopsy) and (C) completion of ERT as planned (complete ERT or incomplete ERT).

Table 3. Summary of Patients Including the Surgical Method, ERT Method and Survival Status

No	Age/ sex	WDTC*	Surgical method	Tumor size >5 cm	Gross mass at RT start	ERT aim	RT dose (Gy)/ fx#	Alive/dead	Survival** (months)
1	57/F	No	Near TT†	No	No	C‖	55.8/31	Alive	104
2	47/M	Yes	Tracheostomy, mass removal††	Yes	Yes	P¶	30/10	Alive	83
3	66/F	No	TT with LND‡	No	No	C	50.4/28	Dead	44
4	77/F	No	TT	No	No	C	61/33	Dead	24
5	62/F	Yes	Mass removal††	Yes	Yes	C	70/35	Dead	21
6	58/F	No	TT with LND	Yes	No	C	60.4/33	Dead	19
7	76/F	No	STT§,††	Yes	Yes	P	6/2§§	Dead	13
8	66/F	No	TT	Yes	No	C	50.4/28	Dead	6
9	66/F	No	Lobectomy††	Yes	Yes	C	45/15	Dead	5
10	57/F	Yes	Extended TT	Yes	Yes	C	50.4/28	Dead	4
11	57/M	Yes	TT	Yes	Yes	P	21.6/12,††,§§	Dead	3
12	68/F	Yes	TT with LND	Yes	Yes	P	37.5/15	Dead	3
13	81/M	No	No	Yes	Yes	P	30/10	Dead	2
14	64/M	Yes	Near TT	Yes	Yes	P	27.2/15§§	Dead	2
15	67/F	No	No	Yes	Yes	P	12.5/5§§	Dead	1
16	78/M	No	No	Yes	Yes	P	18/6§§	Dead	1
17	65/F	No	TT††	Yes	Yes	P	9/3§§	Dead	1

*associated with a well-differentiated thyroid carcinoma, †total thyroidectomy, ‡lymph node dissection, §subtotal thyroidectomy, ‖curative, ¶palliative, #fraction, **survival after surgery or a biopsy, ††palliative resection, ††neck 21.6/12 and L-spine 30/10, §§incomplete ERT

resection, five patients after palliative resection and three patients after a biopsy) started ERT with a gross mass present and only six patients could complete the planned course of ERT. Among the six patients who completed ERT, two patients showed marked regression of the tumor mass, two patients showed slight regression of the tumor mass and two patients showed no response to treatment.

3. The characteristics of patients that survived for more than one year (long-term survivors)

Seven of 17 patients (41%) survived for more than one year and two of the patients survived for 104 months and 83 months, respectively. As shown in Table 3, three patients had an initial tumor with a size of 5 cm or less and the pre-ERT status of the tumor site did not show the presence of any gross mass in four patients. These long-term survivors had a tendency to have a smaller size initial tumor and a pre-ERT tumor mass present than the short-term survivors. Five of seven patients were treated with a curative intent and six patients completed the planned course of ERT (curative or palliative).

4. The characteristics of patients that survived for three months or less (short-term survivors)

Seven of the 17 patients (41%) survived for three months or less; therefore, it is suggested that ERT did not improve treatment. As shown in Table 3, no patient had an initial tumor with a size of 5 cm or less, and the pre-ERT status of the tumor site showed the presence of a gross mass in all patients due to a large initial mass or rapid re-growth at the surgical site. These short-term survivors had a tendency of having a larger size initial tumor and a pre-ERT tumor mass present as compared to the long-term survivors. All of the patients were treated with a palliative intent and only two of the seven patients completed the planned course of palliative ERT.

Discussion and Conclusion

Anaplastic thyroid carcinoma is one of the most difficult malignant diseases to treat for radiation oncologists due to its rarity, very poor prognosis and emergent conditions that can occur during treatment such as severe dyspnea during ERT.

Table 4. Summary of Published Treatment Results for Anaplastic Thyroid Carcinoma

Authors (published year)	No. of patients	Treatment group	Median survival (months)	Survival (%)	Mean survival (months)
Kim *et al.* (2001)	20	1) Curative resection (7) 2) Palliative resection (8) 3) No surgery (5)	5.5 (1~51.4)	1-year: 27 2-year: 27 4-year: 18	1) 33.0±7.9 2) 3.3±0.8 3) 4.2±1.3
Chang *et al.* (2004)	47	Overall (47) 1) Biopsy only (10) 2) Biopsy and CRT* (8) 3) Debulking only (7) 4) Debulking and CRT (14) 5) Complete excision and CRT (8)	Overall 3 (1~21) 1) 2 (1~5) 2) 3 (2~7) 3) 3 (1~5) 4) 3 (2~9) 5) 6 (5~21)		Overall 4.3 1) 2.1 2) 3.6 3) 3 4) 3.5 5) 9.4
Tan *et al.* (1994)	21	Total (21) 1) Complete resection (5) ±postop RT† (4) 2) Incomplete resection (16)	4.5 (0.3~171) 1) 26 (8~171) 2) 3 (0.3~17)	1-year: 24 2-year: 14 5-year: 10	
Busnardo *et al.* (2000)	39	1) TT‡, RT and CT§ (16) 2) Distant metastasis; CT (9) 3) Poor general condition (14); Local RT (4) No treatment (10)	1) 11 (3~27) 2) 5.7 (2~60) 3) 4 (1~11)	1-year: 18 2-year: 8 5-year: 3	
Haigh *et al.* (2001)	33	1) Potentially curative resection with CT and RT (8) 2) Palliative resection of neck disease (18) ±CT and RT (16) 3) CT and RT (7)	Overall 3.8 (0~67) 1) 43 2) 3 3) 3.3	2-year: 20 5-year: 14	

*chemoradiotherapy, †radiation therapy, ‡total thyroidectomy, §chemotherapy

Survival longer than one year is rare. There is controversy about the necessity of postoperative ERT in resectable patients and the use of palliative ERT in unresectable patients. Poor survival has been reported despite the use of ERT in some studies and there are limited studies about the role of ERT for the disease.[2,3,5,8~11] Most worldwide studies have included a small number of patients (21~39 patients), as shown in Table 4.[3,5,6,8,9] Therefore, patients treated with ERT are rarely reported. In Korea, two studies have reported treatment results of anaplastic thyroid carcinoma before 2006. In the first study,[1] 12 of 20 patients were treated with ERT and in the second study,[2] 30 of 47 patients were treated with ERT. In a study by Kim et al.,[1] the use of adjuvant ERT was a favorable prognostic factor in resected cases (p=0.003). In our hospitals, surgeons usually refer patients with anaplastic thyroid carcinoma for ERT after surgery or a biopsy. In the study by Chang et al.,[2] it was concluded that nearly all anaplastic thyroid carcinomas are resistant to the use of ongoing treatment modalities and continue to present a therapeutic dilemma, even though a small improvement of survival was observed with complete excision and aggressive multimodality therapy, and a more effective treatment regimen should be sought for improving the survival rate.

In the present study, the overall survival rate was 41% at 1-year, 24% at 2-years, and 12% at 5-years (Fig. 1). The median survival was 5 months (range, 1~104 months) and the mean survival was 21 months. This result is similar to the findings in the study by Kim et al. In the study by Kim et al., the median survival of anaplastic thyroid carcinoma (20 patients) was 5.5 months and the 2-year survival rate was 27.3%.[1]

In our experience, the 1-year overall survival was 41% (Fig. 1). This level of survival was better than that of previous studies (Table 4). The characteristics of seven patients that survived for more than one year (long-term survivors) were as follows. The initial tumor size was 5 cm or less in three patients and the pre-ERT status at the surgical site showed no recurrence in four patients, suggesting that a small tumor volume is related to favorable survival (Table 2). In addition, the intent of ERT was curative in five patients and the planned dose schedule was delivered in six patients.

Seven patients survived for three months or less (short-term survivors). We think that ERT did not offer any advantage for these short-term survivors. The characteristics of short-term survivors are as follow. The initial tumor size was more than 5 cm in all patients and the pre-ERT status at the surgical site showed the presence of a gross mass in all patients, suggesting that a large tumor volume is related to unfavorable survival and a decreased role of the use of ERT. In the study by Kim and colleagues, for the long-term survivors of two years and more, five of the 20 patients (25%) were female, with a mean age of 54 years, a mean tumor size of 3.2 cm, and without distant metastases. All of these patients were treated with a curative resection and with postoperative ERT.[1] A small tumor size and undergoing postoperative ERT seem to be the common characteristics of long-term survivors in both the present study and the study by Kim et al.[1]

The known prognostic factors for survival that have been reported in the literature are age,[10] gender,[9] size of the tumor,[4,6,12,13] the presence of an intrathyroidal tumor,[10] the presence of acute symptoms,[12] distant metastases,[1,12] leukocytes,[12] lesions found incidentally within a well-differentiated thyroid carcinoma,[13] curative surgical resection,[1,6] complete resection[8] and postoperative radiotherapy.[1,10] In this study, surgery, complete postoperative ERT, the number of primary tumors and tumor size were significant prognostic factors. However, age, gender, coexistence of a well-differentiated thyroid carcinoma, the first malignancy, the presence of a gross mass at the start of ERT, and ERT intent were not significant prognostic factors. Among several factors analyzed in the study by Kim et al.,[1] a tumor size smaller than 5 cm (mean survival 43.9 months versus 3.8 months; $p<0.001$), the absence of distant metastases at presentation (22.9 versus 3.8; p=0.020), patients that were selected for curative surgical resection (33.0 versus 3.3; p=0.002) and postoperative radiotherapy (27.1 versus 2.7; p=0.003) were associated with a prolonged survival time. It is suggested that tumor size, surgical resection and complete postoperative ERT are the common and important factors for survival.

In this study, the survival after palliative resection (5 patients, 24.6±13.4 months) was not worse than that after curative resection (9 patients, 23.2±10.5 months) and different from the survival for patients treated with palliative resection in other studies.[1,8] It might be due to long survival in one patient (83 months) among small numbers in palliative resection group. Kim et al. have shown the significant difference (p=0.002) of the mean survival between curative resection (7 patients, 33.0±7.9 months) and palliative resection (8 patients, 3.3±0.8 months).[1] Kihara et al. have also shown complete resection (4 patients) resulted in 6-month and 1-and 2-year survival rates of 100%, 75%, and 50%, whereas incomplete resection (6 patients) resulted in 6-month and 1-and 2-year survival rates of 17%, 17%, 0%, respectively. Survival after complete resection was significantly better than that after incomplete resection (p=0.0356).[8] The survival for the nonoperative patients is very poor in common.[1,8] In this study, the mean survival for patients without surgical resection (3 patients) was 1.3±0.3 months. In other studies, the mean survival was 4.2±1.3 months in 5 patients[1] and 6-month and 1-year survival rates were 11% and 0% in 9 patients.[8]

All of the patients in the present study received ERT with or without surgery and completely or incompletely. In this study, six of 17 patients (35%) did not complete the planned courses of ERT, curative or palliative. ERT was interrupted due to poor tolerance during ERT (severe dyspnea). All of the interrupted patients except for one patient (survival, 13 months) survived for three months or less. Three patients received a curative resection but showed rapid re-growth of the tumor at the surgical site before ERT. The other three patients received ERT after a biopsy without surgery. In our experience, patients with an initial huge tumor (more than 5 cm) and no surgery before ERT or with a rapid re-growth of the mass at the surgical site have a greater possibility to interrupt of ERT and a short survival. Therefore, the role of ERT is very limited and the omission of ERT could be considered in such cases.

This study has some limitations. These limitations include a small number of cases and the retrospective nature of the study. It is suggested that patients with a small initial tumor ($\leq$5 cm), or treated by surgery (a curative resection or a palliative resection) before ERT, and no rapid re-growth of the mass at the surgical site at the commencement of ERT would be good candidates for postoperative ERT. In contrast, patients with an initial huge tumor (more than 5 cm), no surgery before ERT or rapid re-growth of the mass at the surgical site have a greater possibility of interruption of ERT and short survival. In these cases, the role of ERT is very limited and the omission of ERT could be considered.

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국문초록

미분화 갑상선암에서 방사선치료 순응도와 생존기간

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목 적: 본 연구는 미분화 갑상선암 환자에서 방사선치료에 대한 치료순응도와 치료 성적을 분석하고자 하였다.

대상 및 방법: 1993년부터 2002년까지 미분화 갑상선암으로 외부방사선치료를 시행받았던 17명을 대상으로 후향적으로 분석하였다. 외부방사선치료는 14명에서 수술 후에 시행하였고, 3명에서 조직검사 후에 시행하였다. 수술이 시행되었던 14명의 수술 방법은 9명은 근치적절제술, 5명은 고식적절제술이었다. 고분화 갑상선암이 6명에서 동반되어 있었고, 진단 당시 암의 크기가 5 cm보다 컸던 경우는 14명이었다. 총방사선량은 6~70 Gy (중앙선량, 37.5 Gy)이었고, 11명은 예정된 방사선치료를 끝낼 수 있었고, 6명에서는 방사선치료가 중단되었다. 추적기간은 1~104개월로 중앙값이 5개월, 평균값이 20개월이었다.

결 과: 5명에서는 방사선치료를 시작할 당시에 육안적 종양이 없었으며, 5명 모두 종양의 재성장 없이 방사선치료를 잘 끝낼 수 있었다. 나머지 12명에서는 방사선치료를 시작할 당시 육안적 종양이 있었는데, 이 중 4명은 근치적절제술 후에 바로 암이 자란 경우였고, 5명은 고식적절제술, 3명은 조직검사만을 받은 상태였다. 육안적 종양이 있었던 12명 중 6명 만이 예정된 방사선치료를 끝낼 수 있었는데, 2명에서는 방사선치료로 종양의 크기가 현저히 감소하였고, 2명은 약간 감소, 2명은 무반응이었다. 전체 환자의 생존기간은 1~104개월의 범위로 중앙 생존기간은 5개월이었고, 평균 생존기간은 21개월이었다. 1년, 2년, 5년 생존율은 41%, 24%, 12%이었다. 원발암수, 종양크기, 수술, 방사선치료 완료가 의미있는 예후인자였다. 장기 생존자는 단기 생존자에 비해 진단 당시와 방사선치료 시작 당시에 암의 크기가 작은 경향이 있었다.

결 론: 진단 당시 암의 크기가 5 cm 이하, 방사선치료 전에 수술 시행(근치적 또는 고식적), 수술 부위에 종양의 빠른 재성장이 없는 환자들이 수술후 방사선치료의 좋은 지원자가 될 수 있음을 시사하며, 그와 반대인 경우는 방사선치료가 중단되기 쉽고 생존기간이 짧았기 때문에 방사선치료의 역할이 매우 부족하여 방사선치료를 시행하지 않을 수도 있겠다.

핵심용어: 미분화 갑상선암, 방사선치료, 치료순응도