Quality of Life Research (2007) 16: 65–74
DOI 10.1007/s11136-006-9113-0

Quality of life of nasopharyngeal carcinoma survivors in Mainland China

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Accepted in revised form 20 August 2006

Abstract

The aim of this study is to evaluate the quality of life (QoL) of nasopharyngeal carcinoma (NPC) survivors. 192 NPC survivors treated in 1999 and 2000 were enrolled in this study. Median follow up was 3.6 years (range 2.4–4.6 years). The Chinese SF-36 questionnaire and a self-reported symptom checklist consisting of 14 items were completed at clinics. Sociodemographic factors and clinical information were also collected. Most functional domains of the Chinese SF-36 were significantly worse in NPC survivors compared to the normal population. Xerostomia, hearing loss, hypomnesia, dysphagia, and trismus were frequently reported symptoms. Sociodemographic variables including gender, age, dialect, educational level, monthly income, economic status, and number of comorbidities were univariate predictors of different SF-36 domains and symptoms. Patients with earlier T and N stage, irradiated by linear accelerator, with lower dose and weekly dose to nasopharynx and neck, and those who had anterior nasal radiation field reported better QoL. Multiple stepwise regression analysis showed that the number of comorbidities, monthly income, age, and T stage were independent factors affecting global QoL. We concluded that NPC survivors had worse QoL than the normal population and improving radiotherapy might increase physical and functional domain of QoL.

Key words: Chinese SF-36, Nasopharyngeal carcinoma, Quality of life, Radiotherapy

Abbreviations: Gy – Gray; 3D-CRT – Three-dimensional conformal radiotherapy; IMRT – Intensity-modulated radiotherapy; ^{60}Co – Cobalt-60

Introduction

Nasopharyngeal carcinoma (NPC) has a striking geographical and ethnical distribution. The incidence rates of NPC are low throughout most of the world, which is usually less than 1 per 100,000 [1]. However, it occurs with high frequency in southern China and Southeast Asia. The incidence rate of NPC in Guangdong Province is the highest in the world. The incidence rate per 100,000 males is as high as near 40 in the Cantonese-speaking population in Guangdong Province [2]. Therefore, the research on NPC in this area has special predominance and significance.

At present, radiotherapy (RT) alone or in combination with chemotherapy is the main therapy for NPC. With the increase of curative effect, many NPC patients can survive for a long time. Ma et al. reported that the 5-year overall survival rate of NPC patients was about 60% in Cancer Center, Sun Yat-sen University [3]. However, radiotherapy can cause long-term side effects and affect critical functions such as speech, swallowing, and hearing, as well as a patient's cosmesis, social

functioning, and sense of well-being. So patients' quality of life (QoL) is especially crucial.

Quality of life within the Radiation Therapy Oncology Group (RTOG) is defined as the ability to perform everyday activities in the physical, psychological and social domains of life and patient's satisfaction with levels of function, as well as the control of disease and/or treatment-related symptoms [4]. Because of the rarity of NPC, few studies focusing on NPC patients' QoL were reported in western countries. In Mainland China, NPC patients' QoL is an interesting topic to researchers. QoL includes physical and functional well-being, emotional well-being, social functioning, and occupational well-being domains [5]. We assume that QoL could be affected by sociodemographic and medical factors. Taking these factors into account, this research was designed to evaluate the QoL of NPC patients with cancer-free survival after treatment and to investigate the factors influencing their QoL.

Patients and methods

Study design and subjects

Eligibility criteria included the following: (1) patients came from Guangdong Province; (2) pathologically proven NPC; (3) RT in 1999–2000 and regular follow-up at the Cancer Center, Sun Yat-sen University; (4) cancer-free survival after treatment; and (5) completion of the self-reported questionnaire. The center is located in Guangzhou, the capital of Guangdong Province, which is the largest center for cancer prevention and treatment in southern China. NPC patients from all areas of Guangdong Province tend to be treated there. For this reason, the NPC cases in this center well represent those around Guangdong area [6]. The cancer-free status of patients was confirmed by results from clinical examinations and recent image studies. Patients with therapeutic surgery, local relapse, metastasis or other primary site cancer were excluded.

Patient characteristics

Between July and August 2003 a total of 200 eligible patients were presented at the Cancer Center, Sun Yat-sen University. 8 patients refused to participate due to personal reasons. 192 patients were enrolled in the study. There were 137 male patients and 55 female patients, with a male:female ratio of 2.49:1. Age ranges from 18 to 78 and the median age was 49.5 years old. Histologically, 99.5% of the patients had World Health Organization (WHO) type II or type III; the rest (0.5%) had WHO type I [7]. The pretreatment cancer stages were staged according to the 1992 Fuzhou, China staging system on NPC [8]. This staging system is essentially similar to the fifth-edition UICC TNM staging criteria for NPC [9]. There were 14 stage I, 55 stage II, 87 stage III, and 36 stage IV patients. Survival time was calculated from the date that RT was completed, until the date the patient completed the questionnaire. Median follow up was 3.6 years (range 2.4–4.6 years).

Concerning the existence of selection bias, we compared the distributions of characteristics (including age, gender, TNM stage) between NPC survivors in this study and all other eligible NPC patients found in the cancer registry database in the department. No statistically significant differences were found between them.

Treatment

All patients were treated according to the guideline of the department. Megavoltage photons (6 MV or cobalt-60) were used to treat the primary tumor and neck lymph nodes. The patients were treated by conventional fractionation (radiotherapy was given 5 times a week at 2 Gy/day). Irradiation fields were chosen according to the extent of the tumor. The whole course of therapy was given by a technique that consisted of two lateral-opposed facial fields, supplemented by an anterior field for patients with small tumors confined to the nasopharynx. An anterior cervical field was used to treat the neck with a laryngeal block. Patients were irradiated with large fields to 40 Gy, followed by boost fields to primary tumor areas to 60–80 Gy, depending on the tumor stage. The accumulated dose to the involved areas of the neck was 54–76 Gy and 50 Gy to the uninvolved areas. Intracavitary afterloading treatment with Iridium-192 (Ir-192) was performed for early T stage or local persistence 2–3 weeks after external radiotherapy (20–24 Gy/4–5 fractions/2 weeks to 1 cm above the midpoint of the Ir-192 source). Chemotherapy included neoadjuvant, concurrent and adjuvant chemotherapy. The regimens used

were single agent of cisplatin or a combination of cisplatin and 5-fluorouracil, administered i.v.

Instrumentation

The instruments used in the study consisted of the following four parts: the Chinese SF-36, the self-rating symptom checklist, the sociodemographic items, and the medical data lists.

The SF-36, a generic instrument developed by the Medical Outcomes Study Group, was selected for use in this study. The reasons for this choice included the following: (1) The SF-36 is one of the most common used QoL instruments internationally; (2) The validity of SF-36 has been rigorously evaluated; (3) The Chinese SF-36 is readily available [10]; (4) The SF-36 is suitable for the normal population, and SF-36 data for a variety of normal population groups are available for comparison; (5) The SF-36 provides a comprehensive health survey that can be completed at a clinic in 10 min; and (6) No international disease specific instrument is available in Chinese at present. The SF-36 included 36 questions in eight functional domains including physical functioning (PF), role limitation due to physical functioning (RP), role limitation due to emotional problems (RE), social functioning (SF), bodily pain (BP), vitality (VT), mental health (MH) and general health perception (GH). Scores for each ranged from 0 to 100, with high scores indicating better status of the functional domain.

Because of late side effects of radiotherapy, NPC survivors had some symptoms, which belong to the physical and functional well-being domain of QoL. Since SF-36 is a generic instrument and lacks NPC-specific items, a self-rating checklist of 14 related symptoms that commonly occur in NPC patients who receive radiotherapy was also used to assess QoL [11]. The self-rating symptom checklist was validated and consisted of xerostomia, toothache, hearing loss, dysphagia, trismus, neck stiffness, hypogeusia, dysphonia, hyposmia, dysopia, dizziness, headache, fear of cold, and hypomnesia. The severity of each symptom was measured according to a four-point ordinal scale (1 = not at all, 2 = a little, 3 = quite a bit, 4 = very much). A high score indicated a greater severity of symptoms.

The sociodemographic items included gender, age, dialect, educational level, occupational status, marital status, monthly income, economic status, and number of comorbidities. The economic status of individuals was graded into "sufficient," "appropriate," "a little deficient," and "poor." This grading indicated the subjective availability of their income. The comorbidities were chosen from 16 chronic medical diseases including hypertension, diabetes, heart disease, stroke, arthritis, asthma, tuberculosis, chronic obstructive pulmonary disease, peptic ulcer, chronic hepatitis, liver cirrhosis, cataract, glaucoma, chronic renal disease, anemia, and osteoporosis.

The medical data were obtained from the participants' hospital medical records.

Procedure

All data was collected by interview using instruments. Face-to-face interviews were performed. The informed consent for participation was obtained from the participants. 143 patients read the questions by themselves and recorded their choices. Minimal probing was used whenever necessary. 49 patients, who were not familiar with the Chinese characters in the SF-36, were assisted by a trained interviewer, who read the questions in a dialect the participant could understand. Interviewers checked the completed instruments in the presence of patients to eradicate missing data. The mean time of completing the instruments was 10 min.

Statistical analyses

The mean scores of the eight functional domains from the Chinese SF-36 were calculated according to the SF-36 manual [12]. The reliability of the Chinese SF-36 scales was calculated using Cronbach's α coefficient. Alpha coefficients of a magnitude 0.70 or greater were sought as evidence of adequate scale reliability for use at the level of group comparison [13]. Pearson's correlation coefficient was used to examine the correlations between the scales. Spearman's correlation coefficient was used to examine rank correlation. Differences between variables with categorical data were examined using the chi-square test. Univariate analysis of mean scores between groups was performed by the Student's *t* test or analysis of variance. Multiple stepwise regression analysis was used for multivariate analysis. Microsoft SPSS-10.0 software was used for data processing.

Results

The Chinese SF-36 psychometric test

Internal reliability coefficients, mean scores, and standard deviations for the Chinese SF-36 are shown in Table 1. The Cronbach's α internal reliability coefficients were above the standard of 0.7 for all scales except VT and MH, ranging from 0.59 to 0.87. The Pearson interscale correlations were less than the internal reliability coefficient for all scales, indicating excellent discriminative validity between scales.

Comparison of SF-36 for NPC survivors and the normal population

Figure 1 shows that the mean scores for all the functional domains were lower in the NPC survivors than in the normal population, with significant statistical differences found in RP, RE, SF, BP, and GH ($p < 0.05$). The data collected from the normal population was based on 2,249 people in Mainland China [14]. We assumed that the data could represent the normal population in Guangdong Province. The database had respective norms for different age and gender, and the comparison was adjusted in accordance with these differences. The shape of the SF-36 profile of our patients was very similar to that of the normal population, suggesting conceptual equivalence.

Self-rating symptoms for NPC survivors

The Cronbach's α internal reliability coefficient was a 0.84, which meant good reliability. As shown in Table 2, xerostomia (98%) was the first common symptom, followed by hearing loss (69%), hypomnesia (69%), dysphagia (67%) and trismus (66%).

Table 1. Internal reliability coefficients (Cronbach's α), mean scores and standard deviations of scales of the Chinese SF-36 for all participants (n = 192)

Scale	Cronbach's α	Means	SD
PF	0.86	89.8	14.4
RP	0.79	64.3	37.6
RE	0.75	65.8	38.8
SF	0.73	75.8	23.3
BP	0.87	74.7	21.9
VT	0.59	67.8	16.9
MH	0.64	73.1	16.9
GH	0.71	53.6	19.0

Sociodemographic variables associated with QoL for NPC survivors

Table 3 lists the association of SF-36 outcomes for NPC survivors with their sociodemographic variables. No significant association ($p > 0.05$) with any functional domains of SF-36 was found for the variables of dialect, occupational status or marital status. Males had higher scores of RP, BP, VT, and GH than females. The survivors older than 60 years had a higher score of GH than those younger than 60 years. Educational level (BP), monthly income (VT, MH, and GH), economic status (VT and GH), and number of comorbidities (PF, RE, BP, VT, and GH) were also significant variables that associated with most functional domains of SF-36. The survivors with higher educational levels, higher monthly income, more sufficient economic status or no comorbidity tended to enjoy better QoL as detected by SF-36.

The association of the severity (Grades 1–2 vs. Grades 3–4) of symptoms for NPC survivors with sociodemographic variables was also analyzed (data not shown). No significant association ($p > 0.05$) with the severity of symptoms was found in relation to the following variables: age, education level, occupational status, marital status or economic status. Males had less severe symptoms of hearing loss, dysphonia, dizziness, and fear of cold than females, and survivors with more comorbidities reported severe symptoms (trismus, neck stiffness, dysopia, dizziness, and headache). Dialect (neck stiffness and hypogeusia) and monthly income (neck stiffness) also seemed to be significant variables that associated with symptoms. The survivors speaking Cantonese with a higher monthly income tended to have less severe symptoms.

Medical variables associated with QoL for NPC survivors

Table 4 lists the association of SF-36 outcomes for NPC survivors with their medical variables. No significant association ($p > 0.05$) with any functional domains of SF-36 was found in relation to the following variables: N stage, brachytherapy,

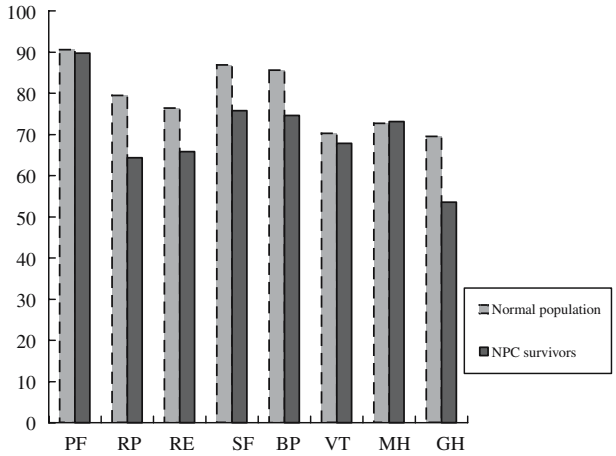

Figure 1. Age and gender adjusted mean scores for the functional domains of SF-36 for NPC survivors and the normal population.

anterior field, chemotherapy, TCM, dose to neck, and survival time. T stage (BP, MH, and GH), irradiation source (BP), dose to NP (BP), weekly dose to NP (RP and RE), and neck (RE) were significant variables that associated with some functional domains of SF-36. The patients with earlier T stage irradiated by linear accelerator, receiving lower dose to NP and lower weekly dose to NP or neck tended to enjoy better QoL as detected by the SF-36.

The association of the severity (Grades 1–2 vs. Grades 3–4) of symptoms for NPC survivors with their medical variables was also analyzed (data not shown). No significant association ($p > 0.05$) with the severity of any symptoms was found in relation to the following variables: brachytherapy, chemotherapy, TCM, and survival time. The patients with earlier T stage had less severe vision problems; with earlier N stage had less severe trismus and neck stiffness dysfunctions. Using anterior nasal radiation field resulted in less severe xerostomia. Many less severe symptoms (xerostomia, hearing loss, dysphagia, trismus, neck stiffness, and fear of cold) were noted in patients who were irradiated by linear accelerator than in those who were irradiated by ^{60}Co. The patients with higher dose and weekly dose rate to NP and neck had severe symptoms (xerostomia,

Table 2. Self-rating symptoms for NPC survivors

	1		2		3		4	
	No.	%	No.	%	No.	%	No.	%
Xerostomia	4	2	73	38	72	38	43	22
Toothache	88	46	74	38	22	12	8	4
Hearing loss	59	31	73	38	33	17	27	14
Dysphagia	64	33	65	34	31	16	32	17
Trismus	65	34	77	40	33	17	7	9
Neck stiffness	80	42	74	38	19	10	19	10
Hypogeusia	115	60	49	26	16	8	12	6
Dysphonia	114	59	59	31	8	4	11	6
Hyposmia	135	70	37	19	15	8	5	3
Dysopia	122	64	49	25	14	7	7	4
Dizziness	103	54	69	36	14	7	6	3
Headache	106	55	70	36	9	5	7	4
Fear of cold	109	57	61	32	14	7	8	4
Hypomnesia	60	31	96	50	25	13	11	6

Note: 1 = not at all, 2 = a little, 3 = quite a bit, 4 = very much.

Table 3. Association between sociodemographic variables and SF-36

	Mean scores								
	No.	PF	RP	RE	SF	BP	VT	MH	GH
Gender			+			+	*		*
Male	137	90.9	69.0	69.1	76.6	77.4	69.6	74.3	55.6
Female	55	87.0	52.7	57.6	73.6	67.7	63.5	70.2	48.5
Age (*yr*)									*
18–40	47	90.4	60.6	60.3	69.1	71.9	65.7	68.9	49.5
41–60	116	90.0	65.7	67.2	78.7	74.4	68.7	74.4	53.8
61–78	29	87.9	64.7	69.0	75.0	80.0	67.9	74.9	59.1
Dialect									
Cantonese	163	90.6	65.3	67.3	75.7	74.9	67.5	73.4	53.6
Others	29	85.2	58.6	57.5	76.3	73.5	69.8	71.3	53.1
Education level						*			
None or primary	41	91.5	61.6	69.9	76.8	78.3	65.0	71.5	54.6
Middle	119	89.6	64.1	63.0	75.3	71.4	67.5	72.7	52.1
High	32	88.3	68.8	70.8	76.2	82.2	72.8	76.9	57.5
Occupational status									
Employed	123	90.8	64.4	67.5	76.5	74.7	67.8	74.2	54.0
Unemployed	69	88.0	64.1	62.8	74.5	74.6	67.9	71.2	52.8
Marital status									
With spouse	183	90.2	64.1	65.8	75.7	74.4	67.6	72.9	53.7
Without spouse	9	81.7	69.4	66.7	77.8	80.6	72.8	76.9	49.9
Monthly income							+	*	*
≤ RMB 500	74	90.3	61.1	62.2	73.1	71.6	64.4	70.4	49.4
501–1000	60	88.3	63.8	67.2	76.9	74.1	66.5	71.9	53.6
> 1000	58	90.6	69.0	69.0	78.0	79.2	73.6	77.9	58.8
Economic status							*		*
Poor	29	89.8	56.9	57.5	72.0	69.6	60.0	70.1	44.7
A little deficient	59	88.4	62.7	63.3	76.1	74.4	66.1	73.7	54.7
Appropriate	82	91.3	68.9	70.7	74.7	75.6	70.4	72.3	54.8
Sufficient	22	87.7	61.4	65.2	84.1	78.3	73.4	78.7	57.7
Number of comorbidities		+		*		+	+		+
0	127	91.3	67.9	69.8	77.6	78.3	70.5	75.2	56.0
1	49	89.4	61.2	63.3	74.7	71.3	64.6	69.0	52.0
≥2	16	78.8	45.3	41.7	64.8	56.1	56.9	69.5	38.9

* p value < 0.05.
+ p value < 0.01.
Underline means higher score, i.e., better QoL.
Abbreviations: PF = Physical functioning; RP = Role physical; RE = Role emotional; SF = Social functioning; BP = Bodily pain; VT = Vitality; MH = Mental healthy; GH = General health.

toothache, dysphagia, neck stiffness, hypogeusia, dysphonia, hyposmia, and dizziness).

Multivariate analysis

A multiple stepwise regression model based on significant univariate relationships was analyzed to explore independent variables predicting patients' QoL. Because aggregating individual items into a total score didn't necessarily represent global quality of life [15], we used GH (General Health) as a measure of the dependent variable, global QoL. As shown in Table 5, the number of comorbidities, monthly income, age, and T stage were independent factors affecting global QoL. No correlation was found among these four variables by correlation analysis.

Table 4. Association between medical variables and SF-36

	Mean scores								
	No.	PF	RP	RE	SF	BP	VT	MH	GH
Overall stages (92′ Fuzhou)								+	
I	14	94.3	62.5	61.9	76.8	78.4	65.4	66.0	61.1
II	55	91.5	65.5	72.7	77.0	76.9	68.4	71.7	55.3
III	87	88.6	64.1	64.4	75.6	75.9	69.9	77.3	54.2
IV	36	88.2	63.9	60.2	74.0	66.6	62.9	67.9	46.5
T stages						*		*	*
T1	29	90.7	56.9	60.9	79.3	80.3	65.2	67.0	56.2
T2	67	93.1	72.8	73.1	78.2	74.7	71.5	75.5	57.4
T3	67	86.9	60.4	64.7	73.5	76.3	67.6	75.8	52.3
T4	29	87.6	61.2	65.8	72.0	65.1	62.6	67.7	44.8
N stages									
N0	66	92.0	62.9	64.1	76.3	77.7	68.0	73.5	55.4
N1	71	88.2	63.7	68.5	73.2	72.9	67.3	71.9	52.3
N2	46	88.7	65.2	61.6	78.3	73.2	69.7	75.9	52.2
N3	9	91.1	75.0	77.8	79.2	73.9	62.2	65.3	56.8
Irradiation source						*			
^{60}Co	127	89.8	60.8	64.3	74.5	71.7	66.2	72.4	51.7
Linear accelerator	65	89.6	71.2	68.7	78.3	80.3	71.1	74.5	57.2
Brachytherapy									
Yes	19	93.9	77.6	71.9	78.9	74.7	71.1	74.9	58.8
No	173	89.3	62.9	65.1	75.4	74.6	67.5	72.9	53.0
Anterior field									
Yes	20	91.0	67.5	66.7	78.8	81.6	68.0	78.4	53.1
No	172	89.6	64.0	65.7	75.4	73.8	67.8	72.5	53.6
Chemotherapy									
Yes	45	89.2	67.2	65.9	76.7	74.5	69.1	74.3	51.3
No	147	89.9	63.4	65.8	75.5	74.7	67.4	72.8	54.2
TCM									
Yes	56	87.6	64.3	64.3	75.9	72.9	70.5	75.0	56.0
No	136	90.7	64.3	66.4	75.7	75.4	66.7	72.4	52.5
Dose to NP						*			
≤ *70* Gy	159	89.6	63.2	65.0	77.0	76.4	67.9	73.6	54.6
> 70 Gy	33	90.6	69.7	69.7	69.7	66.5	67.4	70.7	48.6
Weekly dose to NP			+	+					
≤ 9.80 Gy	110	91.5	70.9	72.7	77.8	76.5	68.0	73.7	55.2
> 9.80 Gy	82	87.5	55.5	56.5	73.0	72.2	67.6	72.3	51.4
Dose to neck									
≤ 60 Gy	126	89.8	64.3	62.7	75.7	74.7	67.9	73.7	53.2
> 60 Gy	66	89.7	64.4	71.7	75.9	74.6	67.7	72.1	54.2
Weekly dose to neck				*					
≤ 9.59 Gy	100	90.0	67.8	71.7	77.0	73.6	69.1	73.6	55.5
> 9.59 Gy	92	89.5	60.6	59.4	74.5	75.8	66.5	72.6	51.5
Survival time (yr)									
2–3	56	90.5	61.6	63.1	72.3	75.5	69.4	74.4	52.1
3–4	79	90.4	68.7	70.9	76.3	73.1	68.3	72.8	54.9
4–5	57	88.2	61.0	61.4	78.5	76.0	65.7	72.4	53.1

* p value < 0.05.
+ p value < 0.01.
Underline means higher score, i.e., better QoL.
Abbreviations: TCM = Traditional Chinese Medicine; NP = Nasopharynx; PF = Physical functioning; RP = Role physical; RE = Role emotional; SF = Social functioning; BP = Bodily Pain; VT = Vitality; MH = Mental healthy; GH = General health.

Table 5. Result of multiple stepwise regression analysis for global QoL*

Variables	DF	Unstandardized coefficients	SE	*t* Value	*p* Value	Standardized coefficients
Constant	1	44.785	6.420	6.976	0.000	
Number of comorbidities	1	−7.598	2.016	−3.768	0.000	−0.257
Monthly income	1	4.410	1.565	2.817	0.005	0.192
Age	1	5.665	2.063	2.747	0.007	0.186
T stages	1	−2.910	1.401	−2.076	0.039	−0.142

*The SF-36 Health Perceptions scale served as a surrogate measure of global QoL.

Discussion

Nasopharyngeal carcinoma and the therapies for NPC always have a tremendous effect on patients' QoL. Understanding the patients' perspective on QoL and exploring the related factors are helpful when a patient and clinicians are making treatment decisions. As a cross-sectional study, this research used the Chinese SF-36 and a self-rating symptom checklist to measure QoL of NPC survivors, surviving 2–5 years after the therapy.

The version of the SF-36 for Chinese people in Mainland China showed good internal consistency and discriminative validity for the participants of this study. The Cronbach's α of VT and MH did not meet the criterion of 0.70. Our data suggest that NPC survivors have worse QoL than the normal population. The SF-36 showed no obvious cultural discrepancies since it could be well understood by Chinese people.

The self-rating symptom checklist results indicated that xerostomia (98%) was the most frequently reported symptom, followed by hearing loss (69%) and hypomnesia (69%). Grade 3–4 symptoms of dysphagia, trismus, and neck stiffness were also common; Grade 3–4 symptoms of hypogeusia, dysphonia, hyposmia, and dysopia were infrequent. Probably it was because the organs that perform these functions were usually not directly irradiated, except when tumor invasion occurred nearby. In contrast, salivary, ear, temporal lobe, oropharynx, temporomandibular joint, and neck were routinely included in irradiation field and received doses as high as the tumor dose in most situations. Therefore, the dysfunctions reported by patients were severe. If we use new precision RT techniques which spare the parotid gland, middle ear canal, temporomandibular joint, and so on, the long-term QoL of NPC survivors will be improved, especially in cases with early-stage tumors.

Quality of life is a multidimensional conception incorporating physical, psychological, and social domains. Univariate analysis showed that sociodemographic variables including gender, age, dialect, educational level, monthly income, economic status, and the number of comorbidities had influences on different domains of SF-36 and symptoms. It was interesting to find that Cantonese-speaking survivors had fewer complaints of neck stiffness. Cantonese is the major dialect in the Pearl River Delta, which is richer than other places in Guangdong Province. This leads to the assumption that the Cantonese inhabitants may be wealthier and therefore are less likely to be employed as laborers, which may best explain why survivors reported less severe neck stiffness as compared to other groups.

Multivariate analysis showed that sociodemographic variables such as the number of comorbidities, monthly income, and age were independent factors affecting global QoL. Monthly income was an objective index, while economic status was the subjective evaluation of their income. Occupational status just referred to the condition of work (yes or no) in this study. So, there was some difference among these three variables. The survivors with no comorbidity and with a higher monthly income tended to enjoy better QoL. Fang et al. also found NPC patients who had better economic status, higher educational levels, employed occupational status, and fewer comorbidity numbers tended to enjoy better QoL [16]. So, the key steps of promoting QoL should include the prevention and control of chronic conditions, the development of the area's economy, and the improvement of people's income. The older survivors reported a better QoL

than younger ones, which might be due to different expectations of life; of course, improvement of the patient's economic condition is rarely under the control of those providing medical care. QoL evaluations might measure the difference between the "hopes and expectations of the individual and that individual's present experiences" [17]. Younger patients usually had higher life expectancy and the difference between hopes and reality was bigger than in older group, which might be one of the explanations for younger patients reporting worse QoL. Another explanation might be that older survivors had more social experience and more extensive resources, so they performed better than younger ones and had better QoL.

Medical variables reflected state of disease and treatment directly, and were closely related with the frequency of complications. In medical variables, patients with earlier T stage, irradiated by linear accelerator, receiving lower dose to nasopharynx and lower weekly dose to nasopharynx and neck tended to enjoy better QoL as detected by the SF-36. Further analysis revealed that patients of earlier T and N stage reported less severe symptoms, which may be due to a relatively small irradiation field and low dose to related tissues. Those with anterior nasal radiation field reported less severe xerostomia, which might be considered as a confounding variable with small tumors, since an anterior field was used for patients with small tumors confined to the nasopharynx. It should be noted that not all patients with small tumors used anterior field and patients with earlier T stage had fewer complaints of another symptom (vision problem). At the same time, it was known that anterior field could reduce the dose to the parotid gland, which was consistent with less severe xerostomia. Therefore, modification of the anterior radiation field should be considered as a way to improve QoL. Many less severe symptoms were reported by patients who were irradiated by linear accelerator versus ^{60}Co, which might be due to dose advantages associated with the linear accelerator method. Firstly, the linear accelerator method could generate a more favorable depth-dose distribution with an improvement of the field homogeneity. Secondly, the increase of the maximum depth led to better skin sparing and greater dose tolerance of the skin and subcutaneous tissue. Thirdly, the edges of the beams were far more sharply defined than those of a cobalt machine, allowing additional precision in dose delivery. Fourthly, electron beams could be created, of particular value in treating superficial lesions. Lastly, linear accelerator achieved an increased and stable dose rate. The patients treated with higher dose and weekly dose rate to nasopharynx and neck had more severe symptoms. This indicated that increasing dose to nasopharynx and neck might increase dose of normal tissue as well as tumor control probability and lead to more late symptoms impairing QoL. Generally speaking, early reactions of normal tissue were determined by weekly dose and fraction size, and late reactions would depend primarily on total dose, size of dose per fraction, and interfraction interval [18]. But this research assuredly observed the association between weekly dose and symptoms, which were likely to be late reactions. Whether it was because of the correlation between early and late reactions requires further investigation [19]. Brachytherapy had no influence on symptoms, which was consistent with the result reported by Hammerlid et al. [20].

To radiation oncologists, how to improve treatment to increase patients' QoL is the main purpose of analyzing QoL. Multivariate analysis of medical variables indicated that T stage was an independent influencing factor, but medical personnel cannot change this variable. However, stage could indicate that the linear accelerator method is more effective with earlier stage patients. Univariate analysis suggested that using linear accelerator and anterior nasal radiation field could improve physical and functional domains of QoL. Decreasing dose to nasopharynx and neck areas could increase QoL, but it might reduce tumor control probability, which was impractical in conventional RT. If applying conformal RT, such as 3D-CRT and IMRT decreased dose to normal tissue but maintained dose to tumor, QoL may be elevated. Lin et al. used IMRT for head-and-neck cancer and found a statistically significant correlation between patient reported xerostomia and QoL; both xerostomia and QoL scores improved significantly over time during the first year after therapy [21]. Parliament et al. found IMRT could highly preserve oral health-related quality of life at both 1 and 3 month post RT [22]. Adjusting weekly dose to improve QoL needs further investigation.

Acknowledgments

The authors would like to thank Mr Yan-Fu Zhou, Mr Mu Chen, Mr Ke-Jie Wu, Mr Jin-Yu Chen, Mr Yu-Jun Li and Mr Zhan-Qiang Zhang for their assistance with data collection and processing, Ms Amy Hamilton, Mr Jian-Qiang Feng and Mr Guan-Heng Hu for their assistance in English editing.

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