# ORIGINAL STUDIES

## Cancer of the larynx in Puerto Rico

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***Introduction*: Cancer of the larynx is the fourteenth most common cancer in the world. The purpose of this cross-sectional study is to examine the characteristics of laryngeal cancer in Puerto Rico. The study evaluates whether this type of cancer is increasing, to what degree gender differences occur; and describe common types of medical treatment.**

***Method*: Information on cases of laryngeal cancer for the period of 1997 to 2002 was collected at the Puerto Rico Central Cancer Registry, Department of Health. The incidence of laryngeal cancer in Puerto Rico during the study period was estimated. Sex differences in case-fatality rate and other variables were analyzed. Medical treatments for laryngeal cancer were also analyzed.**

***Results*: The study revealed that the average incidence of laryngeal cancer in Puerto Rico was 3.8 x 100,000 from 1997-1998 and 3.5 x 100,000 from 2001-2002 (-1.07 APC). Of all the cases (n=848) of laryngeal cancer reviewed, 88% were male. Females were more likely to be diagnosed before age 50 than males (p=0.02). In this study, women had twice the probability of being alive at the end of the study period (OR=1.97; CI:1.14-3.45). The two most frequent types of single treatments for laryngeal cancer were radiation (39%) and surgery (33%).**

***Conclusions*: Cases of laryngeal cancer are decreasing in Puerto Rico. Significant differences by sex were observed, especially the stage of the disease at the time of diagnosis. Future studies on medical treatment modalities that better preserve vocal function concurrently with voice therapy are recommended.**

*Key words: Cancer, Carcinoma, Epidemiology, Incidence, Laryngeal cancer, Voice disorders, Voice problems.*

Cancer of the larynx is the fourteenth most common cancer in the world (1). If allowed to proceed unchecked, it is life threatening. The frequency of laryngeal cancer was reported to be between 2% and 5% of all malignancies in the United States (2). During 2004, 8,060 new male cases and 2,210 new female cases of larynx cancer were reported in the United States (3). In Puerto Rico, 107 males and 22 females were diagnosed with laryngeal cancer during 1990. The last official population-based cancer report in Puerto Rico was published by the Department of Health in 1993 using 1991 cancer data (4). Mortality from cancer of the oral cavity and pharynx, esophagus, larynx and lung between 1955 and 1989 has been analyzed for the USA, Canada and 14 countries in Latin America (5). Uruguay, Cuba, Argentina and Puerto Rico have the highest rates for these sites among the male population, while Peru, Ecuador, Dominican Republic, Mexico and Colombia have the lowest rates. Among females, Cuba, Colombia and Puerto Rico rank high for these sites, while Mexico, Paraguay, Ecuador and Peru rank low (5).

A recent study, conducted in Poland, described a significant increase of female patients with laryngeal and hypopharyngeal carcinoma during the period 1991 to 2001, with average sex ratio Male:Female = 8:1 (6). The study also revealed that the glottis localization of carcinoma dominated (47.6%), followed by supraglottis (40.8%) and pyriform fossa (7.8%). In the majority of cases, carcinoma of larynx and hypopharynx was diagnosed in the advanced stages (T3 and T4) of the disease, with the highest percentage localization in the pyriform fossa (81.0%) and the lowest percentage in glottis tumors (45.6%). Regional lymph nodes metastases were observed in 46.7% of the group, with the highest percentage of tumors found in the pyriform fossa (82.9%) and the lowest percentage in tumors with glottis localization (33.1%).

A similar study conducted in Sarajevo followed 156 patients who underwent surgical treatment for malignant tumors of the larynx at the ENT Clinics (7). One hundred and forty-three (91.6%) were male, and 23 (8.4%) were

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female. The age distribution was as follows: 0.64% in ages 30-40 years, 16% in ages 40-50 years, 32.7% in ages 50-60 years, and 50.6% were over age 60. Of those, 145 were smokers (93%) and 11 were non-smokers (7%). Histological findings showed that 100% of the cases were squamous cell cancer. Most of the patients were surgically treated by total laryngectomy with unilateral or bilateral dissection and thyroidectomy or lobectomy (29%) or total laryngectomy with thyroidectomy or lobectomy (23%), total laryngectomy (22%). The remainder underwent total laryngectomy with unilateral or bilateral dissection (16%) chordectomy (4%), supraglottic laryngectomy (3%), hemilaryngectomy (2%) and hemilaryngectomy with dissection (1%). All patients were postoperatively irradiated, and in younger patients, chemotherapy was combined with irradiation.

In the City of Sao Paulo, Brazil, incidence rates for laryngeal cancer among males have been decreasing since the late 1980s, while among females, the rates have been stable (8). Approximately 8,000 new cases and 3,000 deaths from laryngeal cancer occur annually in Sao Paulo.

In a study conducted in Puerto Rico by Almodóvar, et al. (1996), data from 134 patients who developed head and neck squamous carcinoma (HNSCC) and attended the cancer clinics of the Otolaryngology Department at the Isaac González Martínez Oncology Hospital between August 1993 and November 1995 were analyzed (9). In this study, the average age at the time of diagnosis was 62.3 years (range 18-94 years), and 80% of the subjects were male. The most frequent primary site in males was the laryngeal area, while in females was the oral cavity. Exposure to alcohol and smoking were identified as predisposing factors in 95% of the patients. Since this study was specifically conducted in patients of only one clinic in Puerto Rico and a limited number of subjects, its findings cannot be considered representative of the Puerto Rican population.

Busquets, et al. (2003) studied 445 Puerto Rican patients with histopathologically confirmed diagnosis of squamous cell carcinoma of the upper aerodigestive tract, identified through the University of Puerto Rico, School of Medicine, Otolaryngology Department, Head and Neck Cancer Clinics between August 1993 and January 2003 (10). Data from these patients included employment history, family history of cancer, concurrent diseases, tobacco and alcohol use, socioeconomic data and environmental exposure. The patients' average age was 64 years (range 18-98 years), and 84.5% of them were male. The most frequent anatomical sites of the primary tumor were the larynx (36.4%) and the oral cavity (29.9%). The majority of patients (61.1%) presented advanced stage disease (III-IV) at the time of diagnosis, and over one-half (55.5%) had moderately-differentiated tumors. Prolonged use of tobacco and alcohol was identified in 88.1% and 79.8% of patients, respectively. The most frequent therapeutic modality was radiation therapy followed by a combination of radiation and surgery. However, since that study only included subjects referred to the cancer clinics of the University of Puerto Rico, which represents approximately one third of all cases, it cannot be considered a population-based study, and its external validity could be questioned.

Laryngeal carcinoma can be life threatening. It can seriously affect voice quality and production, which are essential for daily communication. Information about the incidence of this condition in Puerto Rico is important in order to develop future treatment options, not only by physicians, but by speech-language pathologists and other health related professionals.

This population-based cross-sectional epidemiological study examined the characteristics of laryngeal cancer in Puerto Rico. In this study, epidemiological data from 1997 to 2002 provided by the Puerto Rico Central Cancer Registry (PRCCR), Department of Health was examined. The analysis included age distribution, localization of tumor and stage of the disease at the time of diagnosis. This study also reports sex differences on several variables of diagnosis and treatment for laryngeal cancer. A long-term objective is to obtain information that can be useful in designing strategies for voice and speech conservation initiatives.

The purpose of this study was to answer the following questions: Is laryngeal cancer increasing in Puerto Rico? Are there any sex differences in the case-fatality rate of laryngeal cancer in Puerto Rico? Does sex establish any other differences in this medical condition? What are the most common types of medical treatments for each type and stage of laryngeal cancer?

## Method

For this population-based cross-sectional epidemiological study, the investigator used information available on laryngeal cancer cases for the period of 1997 to 2002, registered by the Puerto Rico Central Cancer Registry (PRCCR), Puerto Rico Health Department. Formal consent to review the information was obtained from the director of the PRCCR after agreeing to comply with regulations that protect the confidentiality of the data and the integrity of the information. When approval was obtained, the PRCCR facilitated an electronic copy of the information on cases diagnosed within the proposed time period (1997 to 2002). The PRCCR also provided population estimates for Puerto Rico by age and municipality for each year

studied. The information provided did not contain personal identification of the cases.

Data were summarized in tables, using Microsoft Excel 2002 (11). Each table contained the number and percentage distribution of the variables studied. The data was organized and analyzed for the total period of time (1997 to 2002), and then, bi-annually (1997-1998; 1999-2000; 2001-2002). The following variables were studied: number of cases of laryngeal cancer, last known status (alive or deceased), sex, age at the time of diagnosis, histological type, stage of the tumor at the time of diagnosis, type of treatment(s), diagnosis method, and diagnosis confirmation. To avoid the possibility of identification of particular cases, data was recoded and grouped.

Therefore, in this study, the investigator estimated the incidence of laryngeal cancer in Puerto Rico during the period of 1997 to 2002. A comparison of the previously mentioned variables by sex was conducted. Finally, the most common types of medical treatments used in Puerto Rico for the intervention of laryngeal cancer were identified.

The average incidence of laryngeal cancer in Puerto Rico during the study period was estimated using the number of laryngeal cancer cases registered during that time period and the average population provided by the PRCCR. Age-specific and sex-specific laryngeal cancer incidence rates were estimated accordingly.

To compare the variables by sex, frequency distributions were evaluated, and $\chi^2$ and p-values were calculated for each variable when appropriate. The prevalence odds ratio was estimated to evaluate the magnitude of the association of patient's characteristics by sex. To identify the most common types of medical treatments for laryngeal cancer, frequency distributions were evaluated, and $\chi^2$ and p-values were calculated using the Epi Info 6 software (2001) (12).

## Results

### Incidence of laryngeal cancer in Puerto Rico

Data from the Puerto Rico Central Cancer Registry, a population-based registry, was used to assess the average incidence of laryngeal cancer in Puerto Rico for the proposed study period. The average incidence of laryngeal cancer in Puerto Rico was 3.73 x 100,000 for the period of 1997 to 2002. When the data was analyzed bi-annually, a slight decreasing trend was observed. Table 1 summarizes the average incidence of laryngeal cancer for the study period.

The data suggests a decreasing trend (-1.07% annual percentage change) when the average incidence of 3.83 cases per 100,000 during 1997-1998 was compared to the average incidence of 3.59 cases per 100,000 during 2001-2002. Nevertheless, the study period is relatively short in order to reach definite conclusions.

**Table 1**. Average incidence of laryngeal cancer in Puerto Rico for the periods 1997-1998, 1999-2000, and 2001-2002.

| | 1997-1998 | 1999-2000 | 2001-2002 |
|---|---|---|---|
| Average Incidence of Laryngeal Cancer (Cases per 100,000) | 3.8 | 3.7 | 3.5 |

Source: Puerto Rico Central Cancer Registry, 2006.

### Sex

Our second research question was answered by sex comparison of the following variables: last known status (alive or deceased), age at the time of diagnosis, histological type, stage of tumor at the time of diagnosis, and method of diagnosis. The patient's last known status refers to the person's vital status (alive or deceased) information registered at the PRCCR. The sex analysis revealed that, of all the cases of laryngeal cancer in Puerto Rico during the study period, 749 (88%) were male, while 99 (12%) were female. In the study period, 81% of females were alive in comparison with 68% of males with laryngeal cancer. Table 2 shows the last vital status by stage of disease at diagnosis for females and males with laryngeal cancer in Puerto Rico during 1997-2002. Our

**Table 2**. Last known vital status of laryngeal cancer cases by stage of disease and sex.

| Stage of disease | Sex | | Total | OR (95% CI) |
|---|---|---|---|---|
| | Female | Male | | |
| In situ or localized | | | | |
| Alive | 30 | 246 | 276 | 5.12 (1.16-31.69) |
| Deceased | 2 | 84 | 86 | |
| Regional | | | | |
| Alive | 7 | 71 | 78 | 0.89 (0.26-3.01) |
| Deceased | 7 | 63 | 70 | |
| Distant | | | | Undefined odds ratio |
| Alive | 1 | 8 | 9 | $\chi^2 = 1.17$ |
| Deceased | 0 | 10 | 10 | $p = 0.28$ |
| Unknown | | | | |
| Alive | 42 | 185 | 227 | 1.86 (0.85-4.17) |
| Deceased | 10 | 82 | 92 | |
| Total | | | | |
| Alive | 80 | 510 | 590 | |
| Deceased | 19 | 239 | 258 | 1.97 (1.14-3.45) |
| | 99 | 749 | 848 | |

analysis revealed that women generally have twice the probability (OR=1.97) of being alive at the end of the study period compared to men, and this difference was statistically significant (95% CI; 1.14-3.45). Females with either in situ or localized disease were 5 times more likely to be alive at the end of the study period than males at the same stage of disease (OR=5.12; 95% CI; 1.16-31.69).

**Table 4**. Frequency of histological types of laryngeal cancer by sex (1997-2002).

| Histological type | Sex | | | | Total Cases | | $\chi^2$ (p-value) |
|---|---|---|---|---|---|---|---|
| | Male | | Female | | | | |
| | N | % | N | % | N | % | |
| Squamous cell carcinoma, non-keratinizing | 451 | 60.21 | 39 | 39.39 | 490 | 57.78 | Including "Other" OR=5.51 (95% CI: 3.44-8.82) $\chi^2$ = 65.48 p < 0.001 |
| Squamous cell carcinoma, keratinizing | 196 | 26.17 | 14 | 14.14 | 210 | 24.77 | |
| Other | 102 | 13.62 | 46 | 46.47 | 148 | 17.45 | Excluding "Other" OR=0.83 (95% CI:0.42-1.61) $\chi^2$ = 0.35 p=0.55 |
| Total | 749 | 100.00 | 99 | 100 | 848 | 100.00 | |

## Age at diagnosis

Approximately one- third (34%) of the cases of laryngeal cancer studied were diagnosed between the ages of 60 and 69. The average age at diagnosis for laryngeal cancer was 64 years (±12 years). During the study period, men were diagnosed with laryngeal cancer at an average age of 65 years (±11 years), while women were diagnosed at an average age of 64 years (±15 years). Our analysis also revealed that females were two times more likely to be diagnosed before the age 50 years than males (OR = 1.99; 95% CI; 1.06-3.73). Table 3 illustrates the number of cases of laryngeal cancer by age group and sex.

**Table 3**. Distribution of laryngeal cancer cases by age group at diagnosis and sex.

| Age groups at diagnosis | Sex | | | | Total Cases | | $\chi^2$ (p-value) |
|---|---|---|---|---|---|---|---|
| | Male | | Female | | | | |
| | N | % | N | % | N | % | |
| < 40 | 12 | 1.6 | 4 | 4.0 | 16 | 1.8 | |
| 40 – 49 years | 54 | 7.2 | 12 | 12.1 | 66 | 7.8 | |
| 50 – 59 years | 182 | 24.3 | 19 | 19.2 | 201 | 23.7 | $\chi^2$ = 13.32 |
| 60 – 69 years | 262 | 34.9 | 34 | 34.3 | 296 | 34.9 | (5 df) |
| 70 – 79 years | 169 | 22.6 | 14 | 14.1 | 183 | 21.6 | p = 0.021 |
| > 80 years | 70 | 9.4 | 16 | 16.2 | 86 | 10.1 | |
| Total | 749 | 100 | 99 | 100 | 848 | 100 | |
| Average ± SD | 65 years ±11 yrs | | 64 years ±15 yrs | | 64 years ±12 yrs | | |
| Median | 65 years | | 65 years | | 65 years | | |

## Histology

The utilization of the morphology of cancer in epidemiological and clinical studies is increasing, since it is often related to etiology and prognosis. Also, the choice of treatment and the assessment of prognosis are influenced by the histological type.

The most frequent histological type of laryngeal cancer reported in Puerto Rico, during the study period (1997 to 2002), was squamous cell carcinoma. In men, 60% of laryngeal cancer cases were squamous cell, non-keratinizing, while this histological type was observed in only 40% of the women with laryngeal cancer. In addition, 26% of males and 14% of females had keratinizing squamous cell carcinoma.

The majority (83%) of laryngeal cancers were squamous cell, which can be further classified into keratinizing and non-keratinizing. If both types of squamous cell carcinomas were grouped, 86% of laryngeal cancers diagnosed in males during the study period were squamous cell and 54% of the female cases were squamous cell type. Females had a higher proportion (46%) of other histological types than males (14%). This difference is statistically significant (OR=5.5; 95% CI: 3.44-8.82), which might suggest different etiologies by sex. If other histological types of cancers are excluded from the analysis, then there is no statistically significant difference (p=0.55) between male and female cases with regard to non-keratinizing and keratinizing squamous cell carcinomas.

## Stage of disease at diagnosis

Table 5 illustrates the stage of tumors at diagnosis by sex. Most of the cases with information on stage of disease had an in situ or localized stage at diagnosis. More than half female patients records (53%) did not have the stage of the disease at the time of diagnosis, compared to 36% in males. Data analyses revealed that women have twice the probability (OR=2.00; 95% CI: 1,28-3.11) of not having the stage of the disease in their records at the time of diagnosis compared to men, and this difference is statistically significant ($\chi^2$=10.61; p=0.001).

## Method of diagnosis

Ninety-nine percent (99%) of all laryngeal cancer cases, both male and female, had histological confirmation of

disease. Very few individuals only had a clinical diagnosis. There was no significant difference (p=1.00, Fisher exact test) between males and females with regard to the confirmation of diagnosis.

**Table 5**. Stage of disease at diagnosis by sex.

| Stage | Sex | | | | Total Cases | | $\chi^2$ (p-value) |
|---|---|---|---|---|---|---|---|
| | Male | | Female | | | | |
| | N | % | N | % | N | % | |
| In situ or localized | 330 | 44.06 | 32 | 32.32 | 362 | 42.69 | Including "Unknown" |
| Regional | 134 | 17.89 | 14 | 14.14 | 148 | 17.45 | $\chi^2$ = 10.90 |
| Distant | 18 | 2.40 | 1 | 1.01 | 19 | 2.24 | (3 df) |
| Unknown | 267 | 35.65 | 52 | 52.53 | 319 | 37.62 | p = 0.012 |
| Total | 749 | 100 | 99 | 100 | 848 | 100 | |

## Treatments

Data on treatment modality was available for a subgroup (64%) of the study population (489 males and 59 females). In this subgroup, there were patients who received more than one type of treatment. The treatment modality for 253 patients is classified by PRCCR as "Unknown". These study findings revealed that in Puerto Rico, the two most frequent treatments for laryngeal cancer are radiation and surgery. Other treatment modalities, such as chemotherapy, hormone therapy or immunotherapy were used, but in lower frequencies. Table 6 illustrates the frequency of the most common treatment modalities used in Puerto Rico during the study period. Even though in Puerto Rico chemotherapy as a single treatment was used in 2% of the patients, chemotherapy is important when considered part of a larynx preservation protocol. The analysis of treatment modalities by sex revealed that in Puerto Rico men have 1.61 higher probability of receiving more than one type of treatment compared to women (OR=1.61; 95% CI: 0.78-3.40).

**Table 6**. Frequency of the most common treatments for laryngeal cancer by sex.

| Treatment | Sex | | | | Total Cases | |
|---|---|---|---|---|---|---|
| | Male | | Female | | | |
| | N | % | N | % | N | % |
| Single treatment | | | | | | |
| • Chemotherapy | 11 | 2.3 | 0 | 0.0 | 11 | 2.0 |
| • Radiation | 193 | 39.4 | 21 | 35.6 | 214 | 39.1 |
| • Surgery | 153 | 31.2 | 27 | 45.7 | 180 | 32.9 |
| Multiple treatments | | | | | | |
| • Radiation and surgery | 94 | 19.2 | 5 | 8.5 | 99 | 18 |
| • Chemotherapy and Radiation | 25 | 5.1 | 3 | 5.1 | 28 | 5.1 |
| • Surgery and Chemotherapy | 3 | 0.6 | 1 | 1.7 | 4 | 0.7 |
| • Chemotherapy, radiation and surgery | 10 | 2.0 | 2 | 3.4 | 12 | 2.2 |

Note: Some patients received more than one type of treatment.

## Stage of disease versus treatment

Stage of disease is one of the most important considerations when treatment modality is being considered. For laryngeal cancer patients with known stage of disease at diagnosis, there was no apparent difference by sex. For those with an in situ or localized disease, the most frequent treatment for males, as well as for females, was radiotherapy. Only 2% of male laryngeal cancer patients and none of the 19 female cancer patients with in situ or localized stage of disease received the chemo-radiation combination. Among cases with regional or distant stage of disease, the most frequent treatment modality for males was surgery, and for females was chemo-radiotherapy combination. We were cautious in the interpretation of this finding due to the small number of cases with complete information on both stages of disease and treatment (23%).

**Table 7**. Treatment modality for laryngeal cancer patients by stage of disease and sex.

| Stage/Treatment | Sex | | | |
|---|---|---|---|---|
| | Male | | Female | |
| | N | % | N | % |
| In situ/Localized | | | | |
| • Chemotherapy | 1 | 0.53 | 0 | 0.00 |
| • Radiotherapy | 109 | 58.59 | 10 | 52.63 |
| • Surgery | 73 | 39.04 | 9 | 47.37 |
| • Chemo-radiotherapy | 4 | 2.14 | 0 | 0.00 |
| Total | 187 | 100.00 | 19 | 100.00 |
| Regional/Distant | | | | |
| • Chemotherapy | 0 | 0.00 | 0 | 0.00 |
| • Radiotherapy | 24 | 32.43 | 1 | 12.50 |
| • Surgery | 33 | 44.60 | 2 | 25.00 |
| • Chemo-radiotherapy | 17 | 22.97 | 5 | 62.50 |
| Total | 74 | 100.00 | 8 | 100.00 |
| Unknown | | | | |
| • Chemotherapy | 1 | 0.80 | 0 | 0.00 |
| • Radiotherapy | 55 | 44.36 | 10 | 38.46 |
| • Surgery | 52 | 41.94 | 16 | 61.54 |
| • Chemo-radiotherapy | 16 | 12.90 | 0 | 0.00 |
| Total | 124 | 100.00 | 26 | 100.00 |

# Discussion

The findings of this study suggest that the incidence of laryngeal cancer (male and female) in Puerto Rico is decreasing at a rate of -1.07 annual percent. In the

United States, the 1989-2003 annual percent change was -2.8 for all races. By the end of the 1990s, a study in the City of Sao Paulo, Brazil also showed a decreasing trend for laryngeal cancer (8). Sao Paulo exhibits one of the highest incidences of laryngeal cancer in the world. The findings of the study conducted in Brazil suggested that incidence rates for laryngeal cancer among males have been decreasing since the late 1980s, while remaining stable among females. The decreasing trend is probably the result of differences in behavior changes when comparing men and women, related to tobacco smoking and alcohol intake, which are considered the primary risk factors for laryngeal cancer (9, 13). Several other risk factors are involved in the pathogenesis of laryngeal cancer, such as occupational hazards, salted meat, fat intake and gastroesophageal reflux.

A significant difference in the number of laryngeal cancer cases by sex was observed in Puerto Rico throughout the study period (1997 to 2002). Of all the cases of laryngeal cancer in Puerto Rico (n=848) during this period, 88% were male. Previous studies suggest that sex (male) is one of the unfavorable prognostic factors for laryngeal cancer patients (14-16). This study finding sustains this conclusion. Other sex differences were observed among the patients with laryngeal cancer. The analysis of patients' last known status (alive or deceased) revealed that at the end of the study period, 81% of female subjects were alive as compared to 68% of the males. The case-fatality rate for men was higher than for women. Rahbar, et al. (2004), showed a statistical significance in the outcome of different treatment modalities, as well as in survival rates by sex of the cancer patient (17). Rahbar found that males were at a higher risk in both aspects. Findings in the Puerto Rican population coincide with Rahbar's results in that females had a greater probability of being alive at the end of the study period.

One-third (34%) of all the cases of laryngeal cancer in Puerto Rico during 1997-2002, regardless of sex, were diagnosed between the ages of 60 to 69 years old. This coincides with findings in a study conducted by Almodóvar, Pérez, Arruza, Morell and Báez in 1996 (9), which revealed that the average age at the time of diagnosis was 62.3 years; while in Busquets et al. (2003) the average age at the time of diagnosis was 64 years old (10).

The most frequent histological type of laryngeal cancer reported in Puerto Rico between 1997 and 2002 was squamous cell carcinoma. Previous studies suggest that squamous cell carcinoma continues to be the most frequent histological type of cancer affecting the larynx (7, 18-20).

Almost all laryngeal cancer cases in Puerto Rico during the study period (99% of patients) had histological confirmation of diagnosis. These findings were in accordance with previous studies (10, 6, 7). Further, Procopio, et al. (2006), stated that "the histological confirmation diagnosis is the most important step in the appropriate management of these tumors [of the larynx] and the prognosis varies according to histological types" (21).

The findings of this study also revealed that when the stage of the disease is known, most of the patients are diagnosed with cancer tumors at in situ or localized stage and that the most common treatments for laryngeal cancer in Puerto Rico were radiation and surgery during the study period. These treatment modalities are generally considered to be the gold standard for treatment of laryngeal cancer. Strojan, et al. stated that "surgery remains the gold standard of treatment. However, concomitant radiochemotherapy emerges as an attractive alternative to mutilating surgical procedures" (22). Other medical researchers agree with Strojan (23-25). A very important finding of our study is that more than half of the female cases (53%) were not staged at the time of diagnosis compared with 36% of males (p=0.01). This finding is particularly important because treatment options should consider stage of disease at diagnosis. Nevertheless, there was no difference in the treatment modality received by male and female laryngeal cancer patients during the study period in Puerto Rico. This suggests that regardless of the stage of the disease at the time of diagnosis, patients generally receive the same cancer treatment.

The scientific literature reveals that in other countries the common treatment for advanced laryngeal cancer is surgery frequently followed by chemotherapy. Surgical removal of advanced cancer results in major anatomical and physiological changes, which significantly affects voice quality. The latest and most recent approach for this type of advanced cancer is concurrent chemotherapy and radiation treatment. In a 1991 study, it was found that the highest rate of organ preservation was among patients treated with concomitant radiation and chemotherapy (26). However, no significant difference in survival was noted among patient groups: the gain being in quality of life. A study conducted in 2003 revealed that simultaneous treatment with chemotherapy and radiation preserves the voice of patients with advanced cancer without compromising survival rates (27). Nevertheless, our findings suggest that in Puerto Rico, the therapeutic combination of chemotherapy and radiation was only used in 5% of laryngeal cancer patients, which suggests that voice quality preservation was not considered. Only 4 of 187 male patients and none of the 19 female patients with in situ or localized laryngeal cancer were treated with the chemo-radiation combination. There is enough evidence that chemoradiation helps preserve the larynx and results

in a better voice quality. Why is this treatment modality not considered as an important option that will impact the quality of life of the laryngeal cancer patients in Puerto Rico? Other researchers have demonstrated that while there is no significant difference in survival, better voice quality is observed when chemo-radiation is used (27). Therefore, survival is not the answer to the stated question.

In conclusion, during the period 1997 to 2000, the number of cases of laryngeal cancer decreased in Puerto Rico (-1.07% annual percentage change). Significant differences by sex were observed, especially concerning case-fatality rates and stage of the disease at the time of diagnosis. The most common treatment methods for laryngeal cancer in Puerto Rico were radiation and surgery, even though the chemoradiation modality better preserves the laryngeal structures. Future studies need to identify the effectiveness of concomitant chemoradiation with voice therapy for patients with laryngeal cancer.

This study described and analyzed laryngeal cancer data provided by the Puerto Rico Central Cancer Registry for cases diagnosed and registered during the period of 1997 to 2002. The last published report from this population-based registry was in 1993 with 1991 cancer data. We recognize that 36% of the data included in this study lacked information regarding treatment. This limitation imposes cautious interpretation of the data.

## Resumen

El cáncer de laringe ocupa la posición número catorce entre los tipos más comunes de cáncer en el mundo. El propósito de este estudio transversal fue examinar las características del cáncer laríngeo en Puerto Rico. Este estudio examina si el cáncer laríngeo está aumentando, a qué grado ocurren diferencias por sexo, y describe los tipos más comunes de tratamiento médico. Para este estudio, se recopiló información en el Registro Central de Cáncer de Puerto Rico, Departamento de Salud, sobre los casos de cáncer laríngeo en Puerto Rico durante el período de 1997 a 2002. Se estimó la incidencia de cáncer laríngeo en Puerto Rico durante el período del estudio. Se analizaron las diferencias por sexo en relación con la razón de fatalidad por caso y otras variables. Igualmente, se analizaron los tipos más comunes de tratamiento para el cáncer de laringe.

El estudio reveló que la incidencia promedio de cáncer laríngeo en Puerto Rico fue de 3.8 x 100,000 en el período de 1997-1998 y 3.5 x 100,000 del 2001-2002 (-1.07 APC). De todos los casos (n=848) de cáncer laríngeo durante el período del estudio, 88% fueron varones. Se diagnosticaron más féminas que varones antes de los 50 años de edad (p=0.02). En este estudio, las mujeres tenían el doble de probabilidad de estar vivas al final del período de estudio (OR=1.97; CI:1.14-3.45). Los dos tipos de tratamiento más frecuentes para el cáncer laríngeo fueron radiación (39%) y cirugía (33%). El riesgo de cáncer de laringe en Puerto Rico está disminuyendo. Se observaron diferencias significativas por sexo, especialmente en lo que se refiere a estadios de la enfermedad al momento del diagnóstico. Se recomiendan estudios futuros sobre modalidades de tratamiento médico concurrentemente con terapia de voz que preserven mejor la función vocal.

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