ORIGINAL ARTICLE

Surgery for Papillary Thyroid Carcinoma

Is Lobectomy Enough?

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Objective: To further understanding of treatment of papillary thyroid carcinoma (PTC).

Design: The Surveillance, Epidemiology, and End Results Program database was searched for patients who had undergone surgery for PTC.

Setting: Areas covered by Surveillance, Epidemiology, and End Results population-based registries.

Patients: Patients who had undergone PTC surgery between January 1, 1988, and December 31, 2001, were included in the study.

Main Outcome Measures: Disease-specific survival (DSS) and overall survival (OS).

Results: Of the total 22 724 patients with PTC, 5964 patients underwent lobectomy. There were 2138 total and 471 disease-specific deaths. Controlling for tumor size, multivariate analysis revealed no survival difference between patients who had undergone total thyroidectomy and those who had undergone lobectomy. Increased tumor size, extrathyroidal extent, positive nodal status, and increased age displayed significantly worse DSS and OS ($P < .001$). Histologically, follicular PTC subtype did not affect DSS or OS. Patients who had received radioactive iodine had poorer DSS but improved OS. Patients undergoing external beam radiation therapy had poor DSS (hazard ratio, 4.48; 95% confidence interval, 3.30-6.06; $P < .001$) and OS (1.71; 1.42-2.07; $P < .001$).

Conclusions: The results of this study compel us to reinvestigate the current PTC surgical recommendations of total thyroidectomy based on tumor size because this may not affect survival across all populations. In addition, the current use of external beam radiation therapy for the treatment of PTC should be reexamined.

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THE AMERICAN THYROID ASSOCIATION guidelines[1] are considered the criterion standard for evidence-based management of papillary thyroid carcinoma (PTC). The current surgical recommendation, which carries an A rating, is that patients with papillary thyroid tumors larger than 1 cm should undergo a near-total or total thyroidectomy (herein referred to as *thyroidectomy*). Lobectomy should therefore be reserved only for patients with selected tumors smaller than 1 cm (unifocal, absence of extrathyroidal spread, no evidence of nodal metastasis). This surgical recommendation is largely based on a recent population-based study by Bilimoria and colleagues[2] that uses the National Cancer Database. More than 50 000 patients with PTC with an average of a 5½-year follow-up were stratified based on their surgical treatment (thyroidectomy vs lobectomy). Through multivariate analysis, recurrence and relative and overall survival (OS) benefits were seen with a more aggressive surgical approach (thyroidectomy) with all tumors 1 cm or larger. This report is the only study, to our knowledge, to demonstrate thyroidectomy survival benefit over lobectomy for PTC tumors 1 cm or larger.[2] The findings of Bilimoria et al are well supported within the careful statistical analysis; however, further questions persist.

See Invited Commentary at end of article

Of note, the study by Bilimoria et al did not report on disease-specific survival (DSS). The decision to forgo DSS analysis was based on data from Percy et al[3] indicating that death certificate reporting is not accurate in population databases. However, when reviewing this study's subanalysis, thyroid cancer death certificate reporting was found to be highly accu-

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rate and dependable.[3] The question then arises as to whether a DSS benefit will be seen with a more aggressive surgical approach (thyroidectomy). In addition, although the National Cancer Database includes many important clinical factors used in the multivariate analysis, variables such as histologic subtypes were not included. Will the addition of histologic PTC subtypes alter the survival benefits seen? Finally, can we demonstrate similar survival benefits within alternate population databases to corroborate and thereby support the American Thyroid Association's recommendations? Herein, we aim to answer these questions. We investigate the effects of surgical therapy in treating PTC using the Surveillance, Epidemiology, and End Results (SEER) Program database. Although the SEER database has been used in the past in PTC research, these specific goals have not yet been reported.[4-6]

METHODS

The SEER Program of the National Cancer Institute is a dependable national cancer registry that is widely used within the United States. SEER currently collects and publishes cancer incidence and survival data from population-based cancer registries covering an estimated 26% of the US population. SEER coverage includes 23% of African Americans and 40% of Hispanics. The mortality rate data reported by SEER are provided by the National Cancer Institute.[7] Updated annually and provided as a public service in print and electronic formats, SEER data were used in more than 400 publications in 2008 alone.

Using the SEER database, a population-based cohort analysis was performed. SEER maintains population-based registries in the following locations: Alaska (Native Alaskans); Arizona (Native Americans); Los Angeles, San Francisco/Oakland, and San Jose/Monterey, California, and the Greater California area; Connecticut; Detroit, Michigan; Atlanta and rural Georgia; Hawaii; Iowa; Kentucky; Louisiana; New Jersey; New Mexico; Seattle/Puget Sound, Washington; and Utah. Patients with cancer of the thyroid between the years of January 1, 1988, and December 31, 2001, were included. The start year of 1988 was chosen because of the initiation of the Extent-of-Disease-10 coding system for thyroid cancers; we were then able to have uniform reporting of the extent of the primary tumor throughout the study group. The cutoff year of 2001 was to allow at least 5-year follow-up data before the 2006 close of the database. This 5-year follow-up gap has been used previously.[2] The patient subset was then limited by specific histologic diagnoses for PTC. Histologic subtypes included the following (*International Statistical Classification of Diseases, 10th Revision [ICD-10]*[8] code): papillary carcinoma, not otherwise specified (NOS) (8050); papillary adenocarcinoma, NOS (8260); papillary carcinoma, follicular variant (8340); papillary microcarcinoma (8341); papillary carcinoma, oxyphilic cell (8342); papillary carcinoma, encapsulated (8343); papillary carcinoma, columnar cell (8344); and papillary cystadenocarcinoma, NOS (8450). These inclusion criteria yielded 27 821 patients.

Exclusion criteria for this study included age younger than 18 years (n=407), tumor size code of 000 (no tumor found) or 999 (unknown) (n=3693), tumor extent code of 99 (unknown extension) (n=206), lymph node code of 99 (unknown whether lymph nodes are positive) (n=61), and the following surgical codes: 00 (none, no surgery of primary site), 01 (incisional, needle, or aspiration biopsy of other than primary site), 02 (incisional, needle, or aspiration biopsy of primary site), 03 (exploratory ONLY [no biopsy]), 04 (bypass surgery, -ostomy ONLY [no biopsy]), 05 (exploratory ONLY AND incisional, needle, or aspiration biopsy of primary site or other sites), 06 (bypass surgery, -ostomy ONLY AND incisional, needle, or aspiration biopsy of primary site or other sites), 07 (non–cancer-directed surgery, NOS), 09 (uncertainty as to which surgery was performed), 13 (local tumor destruction, no specimen sent to pathology laboratory), 70 (thyroidectomy, NOS), 80 (thyroidectomy, NOS), 90 (surgery, NOS), and 99 (unknown whether any surgery performed) (n=730). After exclusion criteria were filled, a cohort size of 22 724 was used in this study.

The following variables were included in the analysis: age at diagnosis, sex, race, histologic subtype, tumor extent, tumor size, lymph node involvement, extent of surgery, radiation therapy (isotopes or external beam), OS in months, and DSS in months. Descriptive statistics were calculated for all variables. Surgical patients were divided into 2 groups: those undergoing lobectomy (including true lobectomies and lobectomies including up to partial contralateral resection) and those undergoing thyroidectomy (including subtotal and total thyroidectomy). Both OS and DSS outcomes were estimated by the Kaplan-Meier method. Tumor size cutoffs for multivariate analysis were as follows: less than 1 cm, 1 to 1.9 cm, 2 to 2.9 cm, 3 to 3.9 cm, and 4 cm or larger. These sizes were chosen to fully incorporate American Joint Committee on Cancer T staging in that, based on greatest dimension alone, thyroid tumors cannot be upstaged for dimensions greater than 4 cm.[9] Stratified analyses using the Cox proportional hazards model were performed for all the listed variables. Hazard ratios (HRs) with 95% confidence intervals were generated. Any HR greater than 1.0 indicate worsened prognosis. $P<.05$ was considered significant. Analyses were performed using the statistical package R (R, version 2.10.1; Institute for Statistics and Mathematics, Vienna, Austria; www.r-project.org).

RESULTS

Of the 27 821 patients with PTC listed in the SEER database between the years 1988 and 2001, 22 724 patients matched inclusion and exclusion criteria and were therefore included in the analyses. The mean (SD) follow-up time was 109 months (9.1 years). From this cohort, the total number of live patients equaled 20 586 (90.6%), the total number of dead patients equaled 2138 (9.4%), and the total number of cause-specific dead patients equaled 471 (2.1%). Patient characteristics are listed in **Table 1**. Noteworthy is the surgical management of lobectomy for 534 patients with advanced T stage (>4 cm). Also of note are the 1185 patients given radioactive iodine (RAI) and 93 given external beam radiation therapy (XRT) who underwent limited surgical resection.

Although a number of variables revealed univariate statistical significance, multivariate analysis is required to conclusively comment on the clinical significance of any of the clinical factors. Therefore, **Table 2** reviews the HRs for OS and DSS, respectively. Although controlling for the remaining variables, the multivariate models revealed that patients with increased tumor size demonstrated poorer OS and DSS. The tumor sizes were divided into progressive groups of less than 1 cm, 1 to 1.9 cm, 2 to 2.9 cm, 3 to 3.9 cm, and greater than or equal

Table 1. Patient Characteristics[a]

Characteristic	No. (%) of Patients		
	All Patients	Lobectomy	Total Thyroidectomy
Patients per group	22 724	5964 (26.2)	16 760 (73.8)
Sex			
Male	4997 (22.0)	1172 (19.7)	3825 (22.8)
Female	17 727 (78.0)	4792 (80.3)	12 935 (77.2)
Age, median (range), y	44 (18-96)	46 (18-91)	43 (18-96)
Race			
White	18 761 (82.6)	4918 (82.5)	13 843 (82.6)
Black	1035 (4.6)	306 (5.1)	729 (4.3)
Other	2806 (12.3)	705 (11.8)	2101 (12.5)
Unknown or unspecified	122 (0.5)	35 (0.6)	87 (0.5)
Histologic subtype			
Papillary, not otherwise specified	12 300 (54.1)	3227 (54.1)	9073 (54.1)
Follicular variant	7200 (31.7)	1976 (33.1)	5224 (31.2)
Papillary adenocarcinoma	3014 (13.3)	691 (11.6)	2323 (13.9)
Other[b]	210 (0.9)	70 (1.2)	140 (0.8)
Size, cm			
<1.0	6542 (28.8)	2657 (44.6)	3885 (23.2)
1.0-1.9	6402 (28.2)	1335 (22.4)	5067 (30.2)
2.0-2.9	4892 (21.5)	950 (15.9)	3942 (23.5)
3.0-3.9	2460 (10.8)	488 (8.2)	1972 (11.8)
4.0-8.0	2285 (10.1)	497 (8.3)	1788 (10.7)
>8.0	143 (0.6)	37 (0.6)	106 (0.6)
Extent of tumor			
Localized	16 814 (74.0)	4990 (83.7)	11 824 (70.5)
Extracapsular spread or locally invasive	5672 (25.0)	944 (15.8)	4728 (28.2)
Metastatic disease	238 (1.0)	30 (0.5)	208 (1.2)
Lymph node involvement			
Positive	5222 (23.0)	556 (9.3)	4666 (27.8)
Negative or undissected	17 502 (77.0)	5408 (90.7)	12 094 (72.2)
Radiation therapy			
None	10 978 (48.3)	4513 (75.7)	6465 (38.6)
Radioactive iodine	10 298 (45.3)	1185 (19.9)	9113 (54.4)
External beam	547 (2.4)	93 (1.6)	454 (2.7)
Radioactive implants	398 (1.8)	51 (0.8)	347 (2.1)
Other, refused or recommended	503 (2.2)	122 (2.0)	381 (2.3)

[a] Data are presented as number (percentage) of patients unless otherwise indicated. Percentages may not total 100 because of rounding.
[b] Includes papillary microcarcinoma, oxyphilic cell, encapsulated, columnar cell, and papillary cystadenocarcinoma.

Table 2. Cox Proportional HRs for Overall and Disease-Specific Survival

Characteristic	Overall Survival		Disease-Specific Survival	
	HR (95% CI)	*P* Value	HR (95% CI)	*P* Value
Tumor size	1.07 (1.03-1.10)	<.001	1.56 (1.44-1.69)	<.001
Extent, localized (vs extrathyroidal)	1.46 (1.33-1.62)	<.001	3.25 (2.56-4.12)	<.001
Node status, referent: negative	1.50 (1.35-1.67)	<.001	2.49 (2.04-3.05)	<.001
Age	1.09 (1.08-1.09)	<.001	1.08 (1.07-1.09)	<.001
Male sex	1.24 (1.18-1.30)	<.001	1.06 (0.95-1.17)	.27
Race, white (vs all other races)	1.06 (0.95-1.19)	.30	0.87 (0.69-1.10)	.24
Surgical type, lobectomy (vs thyroidectomy)	0.93 (0.84-1.03)	.16	0.91 (0.71-1.15)	.41
External beam radiation therapy (vs no radiation)	1.71 (1.42-2.07)	<.001	4.48 (3.30-6.06)	<.001
Isotopes or implants (vs no radiation)	0.92 (0.88-0.97)	.002	1.21 (1.07-1.36)	.002
Histologic subtype, papillary not otherwise specified (vs follicular)	1.01 (0.92-1.11)	.85	0.89 (0.72-1.11)	.31

Abbreviations: CI, confidence interval; HR, hazard ratio.

to 4 cm. With significance ($P<.001$), each tumor size group demonstrated progressively worse OS and DSS; however, the most substantial decrease in survival was seen between the 3- to 3.9-cm and greater than or equal to 4-cm groups (10-year OS decreased by 10.7%; 10-year DSS decreased by 6.6%). Likewise, patients with aggressive tumor spread had decreased OS and DSS. Advanced age and positive lymph nodes reduced OS and DSS. Sex displayed an interesting survival pattern. Although male sex had a significantly ($P<.001$) worse HR

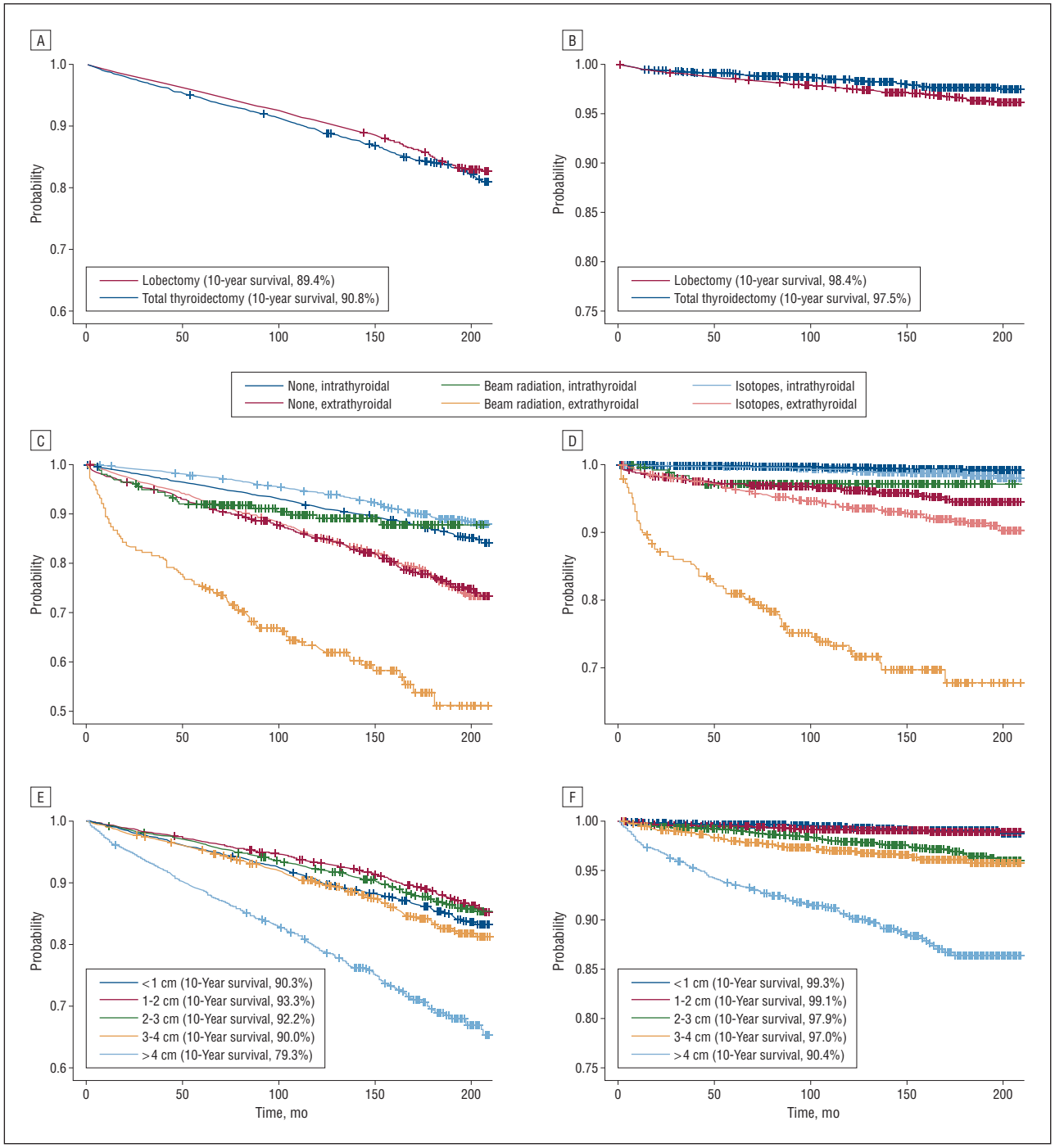

Figure. Kaplan-Meier survival curves. Surgical subgroups demonstrate equivalent overall survival (OS) (A) or disease-specific survival (DSS) (B). The radiation treatment graphs are adjusted for tumor extent. Both OS (C) and DSS (D) are substantially decreased with extrathyroidal tumors treated with external beam radiation therapy. Increased tumor size is most notably seen to decrease both OS (E) and DSS (F) in the subgroup with tumor sizes greater than 4 cm.

(1.24) for OS, men did not show a significant difference in DSS. Patients of races other than white revealed equivalent OS and DSS.

Surprisingly, although controlling for the remaining variables, including tumor size, the surgical groups of lobectomy and thyroidectomy did not reveal any differences in OS or DSS. Even by performing subgroup analysis (data not shown) for tumors 1 cm or larger, no significant difference was found between the surgical groups of lobectomy vs thyroidectomy ($P = .05$ for OS and $P = .09$ for DSS).

Patients undergoing XRT demonstrated significantly worse OS and an almost 4.5-fold increase in disease-specific mortality rate. Patients treated with either RAI or implantable radioactive seeds demonstrated an intriguing survival pattern. The OS demonstrated a modest but significant improvement. However, this pattern reversed when analyzing for DSS in that RAI patients demonstrated poorer DSS than the no-radiation treatment group. Lastly, the histologic subtype papillary carcinoma, follicular variant, did not demonstrate any survival changes.

Table 3. Radiation Therapy Data[a]

Characteristic	No. (%) of Patients			
	All Patients	External Beam Radiation Therapy	Radioactive Iodine	Implants
Patients per group	22 724	547 (2.4)	10 298 (45.3)	398 (1.8)
Size, cm[b]				
<1.0	6542 (28.8)	75 (13.7)	1626 (15.8)	67 (16.8)
1.0-1.9	6402 (28.2)	142 (26.0)	3235 (31.4)	116 (29.1)
2.0-2.9	4892 (21.5)	134 (24.5)	2699 (26.2)	108 (27.1)
3.0-3.9	2460 (10.8)	72 (13.2)	1416 (13.8)	58 (14.6)
4.0-8.0	2285 (10.1)	115 (21.0)	1244 (12.1)	46 (11.6)
>8.0	143 (0.6)	9 (1.6)	78 (0.8)	3 (0.8)
Extent of tumor[b]				
Localized	16 814 (74.0)	253 (46.3)	6827 (66.3)	265 (66.6)
Extracapsular spread or locally invasive	5672 (24.9)	252 (46.1)	3334 (32.4)	128 (32.2)
Metastatic disease	238 (1.1)	42 (7.7)	137 (1.3)	5 (1.2)
Lymph node involvement[c]				
Negative or undissected	17 502 (77.0)	237 (43.3)	6881 (66.8)	142 (35.7)
Positive	5222 (23.0)	310 (56.7)	3417 (33.2)	256 (64.3)
Extent of disease[b]				
Localized tumor and negative lymph nodes	14 003 (61.6)	168 (30.7)	5007 (48.6)	183 (46.0)
Localized tumor and positive lymph nodes	2811 (12.4)	85 (15.5)	1820 (17.7)	82 (20.6)
Nonlocalized tumor and negative lymph nodes	3499 (15.4)	69 (12.6)	1874 (18.2)	73 (18.3)
Nonlocalized tumor and positive lymph nodes	2411 (10.6)	225 (41.1)	1597 (15.5)	60 (15.1)
Surgery[b]				
Lobectomy	5964 (26.2)	93 (17.0)	1185 (11.5)	51 (12.8)
Total thyroidectomy	16 760 (73.8)	454 (83.0)	9113 (88.5)	347 (87.2)
Survival, %[d]				
Overall survival	90.6	75.3	91.7	91.2
Disease-specific survival	97.9	85.2	97.5	98.0

[a] Percentages may not total 100 because of rounding.
[b] $P<.001$ between all groups, except no significant difference between radioactive iodine and implants.
[c] $P<.001$ between all groups.
[d] $P<.001$ only for external beam radiation therapy.

The **Figure** displays the Kaplan-Meier survival curves for surgical type subgroups, radiation treatment subgroups, and tumor size subgroups. The Kaplan-Meier graphs incorporate only a univariate model of survival. Because of the complex nature of OS and DSS regarding radiation treatment, these Kaplan-Meier graphs have been adjusted for tumor extent. A substantial decrease in OS and DSS is seen with tumors extending beyond the thyroid capsule treated with XRT. However, the tumors confined to the thyroid capsule display improved survival curves over both RAI and no-radiation treatment.

Given the surprising survival effects of radiation treatment, the individual variables were stratified among the treatment subgroups in **Table 3**. Each radiation subgroup (XRT, RAI, and implants) consisted of significantly larger tumor sizes, more extensive tumors, and greater lymph node involvement ($P<.001$). All variables were statistically similar between the RAI and radioactive implant groups except lymph node involvement. When reviewing the patient selection for radiation treatment, an impressive 30.7% of patients given XRT demonstrated only localized tumor without evidence of regional or distant metastasis. In addition, 19.9% of all patients treated with lobectomy were referred for RAI completion therapy.

COMMENT

The results of our study compel us to reinvestigate the current PTC surgical recommendations of total thyroidectomy based on tumor size because this may not affect survival across all populations. Analyzing more than 22 000 patients with PTC in the SEER database, no survival benefit was demonstrated with more aggressive surgical therapy (thyroidectomy vs lobectomy). These equivalent surgical outcomes were noted in the multivariate analysis when all tumor size subgroups (<1 cm, 1-1.9 cm, 2-2.9 cm, 3-3.9 cm , and ≥4 cm) were represented. In addition, when repeating the multivariate analysis and selecting out all tumors smaller than 1 cm, no survival benefit could be demonstrated. Our data support previous institutional reviews[10] and National Cancer Database studies[11] that demonstrated no significant survival improvement based on extent of surgical resection. Although the present study can present significantly more substantial analysis than the smaller (n=403) institutional studies,[10] the present study also includes multivariate analysis, which previous population studies exclude.[11]

There are also conflicting data regarding the use of postoperative RAI. This controversy has led to intricate rec-

ommendation 32 in the American Thyroid Association guidelines regarding postoperative RAI administration.[1] In brief, the guidelines state that RAI should be given only to patients with high-risk or advanced-stage PTC. A recent multi-institutional study[12] demonstrated survival data to support this targeted recommendation. However, this study only reported on OS rates. Our study supports this finding that there is improved OS with RAI treatment; however, there is a survival reversal when DSS is analyzed. This may call into question many RAI studies that delineate the survival benefits based on OS alone. Yet, it is not clear why there are opposite survival trends with RAI. Perhaps, DSS is worsened based on patient selection alone as seen in the present study by the higher rates of patients with advanced local and distant disease. On the other hand, patients given RAI may represent a more compliant population who are more likely to continue their endocrinology follow-ups and maintain closer contact to their physicians, thereby improving their OS.

A similar finding is demonstrated by the sex variable as well. Female patients with PTC showed a significant OS benefit in multivariate analysis. However, the statistical significance was lost in DSS. Again, sex differences in OS and DSS benefits may be owing to an increased rate of medical compliance by women. However, it is more reasonable to explain this finding in relation to women's increased longevity (regardless of cancer status),[13] which would affect OS but not DSS. Such hypotheses would need dedicated study for validation.

The role for XRT has only been studied in select PTC patient groups. In each of the studies, XRT has been purposefully selected for aggressive cases. Almost universally, XRT has improved recurrence rates,[14-16] survival rates,[17] or both.[18,19] However, the indications for treatment are highly institutionally specific, making overall comparisons challenging. Although adjuvant XRT is part of the American Thyroid Association treatment paradigm, it still is not a part of mainstream PTC treatment. This may be owing to studies demonstrating equivalent survival,[20] as well as the significant short- and long-term toxic effects of XRT. In the present study, it is evident from the breakdown of patient subgroups that there is a wide range of subgroups being referred for XRT. A total of 168 patients without extrathyroidal spread and without evidence of nodal metastasis were treated with XRT; 42 patients with distant metastasis were also treated with irradiation to the primary site. It is likely that confounding factors led to these irregular treatment choices. As such, the poor radiation survival statistics seen in the present study can likely be ascribed to a selection bias. Many of the patients receiving XRT may have already developed untreatable disease. This is most clearly demonstrated by the difference in OS compared with DSS. Although the HR for OS was 1.71, the HR for DSS increased to 4.48, signifying a much poorer prognosis. Although these statistics may be interpreted as XRT having limited efficacy with PTC, it is much more plausible given the documented success rates that these findings are owing to a severely skewed patient subgroup.

To date, to our knowledge, no randomized trial has addressed the issue of extent of surgical treatment for PTC. Given the large sample size required to demonstrate significance, this is a somewhat arduous task. Current data have therefore been amassed from individual institutional experiences and from cancer registries. Both approaches hold inherent weaknesses. Institutional studies' sample sizes are limited compared with the statistical power that a large registry sample size can create. On the other hand, registry data, such as the SEER database, consist of many limitations. Although the SEER Program holds annual audits and mandates accurate reporting,[7] it is still based on thousands of registrars distributed widely throughout the country. As such, incorrect coding can lead to inaccurate analyses. Specifically, approximately 5000 patients with PTC had inadequate coding and were therefore excluded from the current study. In addition, as addressed in previous studies,[2] 19.9% of patients treated with lobectomy were registered as "administered RAI." This large percentage may in fact be a spurious result from inaccurate coding of iodine 131–labeled uptake scans and not iodine 131–labeled ablative doses. However, the currently reported rate of 54% of thyroidectomy patients receiving RAI is equivalent to the National Cancer Database study by Bilimoria et al.[2] Next, the SEER database uses Native Alaskan and Native American registries as 2 of its 18 reporting sources. Although it is critical that the SEER database continues to include these populations, their inclusion may skew patient distribution from that of a large urban center. Lastly, the lack of tumor recurrence data is a significant limitation of the current study. Optimally, the high-risk variables should be assessed for their recurrence risk in addition to their OS and DSS rates. However, these data were not available within the SEER program. Despite these shortcomings, the SEER Program is a well-used research tool and is widely considered a reliable data source.[21]

Our findings herein suggest that perhaps it is time for a subtle paradigm shift in our approach to PTC. Historically, given the excellent overall prognosis, PTC has been studied as a distinct entity apart from all other carcinomas. To that end, we address this carcinoma distinctly from others in the head and neck. However, as has been taught, we must achieve "adequate surgical resection of the [PTC] disease."[22] Therefore, in place of blanket decision trees mandating which tumor sizes call for lobectomies and which call for thyroidectomies, the goal of PTC surgery should be to clear the disease. Also, although the multicentricity of PTC and risk of contralateral microfoci have been well documented,[23] it is likely these areas can be adequately treated if they ever become clinically evident, and our focus should remain on the primary tumor. With a more tailored treatment strategy toward individual tumors, as opposed to individual tumor criteria, we may continue to improve our patients' rate of survival.

Using the SEER database, the outcomes of 22 724 patients with PTC were analyzed. In conclusion, PTC remains a cancer with good overall prognosis. Factors that decrease DSS and OS include advanced age, increased tumor size, extrathyroidal tumor growth, and regional and distant metastases. However, multivariate analysis revealed that the extent of surgical resection does not impart a significant DSS or OS benefit. The survival benefit

of RAI treatment was unclear because of improved OS but worsened DSS. Patients receiving XRT displayed significantly worse DSS and OS. These data therefore call into question the recommendation of surgical extent based on size criteria alone. In addition, current RAI and XRT practices should be reevaluated.

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Author Contributions: Dr Mendelsohn had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis. *Study concept and design:* Mendelsohn, Abemayor, and St John. *Acquisition of data:* Mendelsohn and St John. *Analysis and interpretation of data:* Mendelsohn, Elashoff, and St John. *Drafting of the manuscript:* Mendelsohn, Elashoff, and St John. *Critical revision of the manuscript for important intellectual content:* Elashoff, Abemayor, and St John. *Statistical analysis:* Elashoff. *Obtained funding:* St John. *Administrative, technical, and material support:* St John. *Study supervision:* Abemayor and St John.
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INVITED COMMENTARY

Extent of Surgery for Papillary Thyroid Carcinoma

The Debate Continues

Mendelsohn and colleagues have written an interesting article. The subtitle "Is Lobectomy Enough?" is intriguing. The answer is simple. Yes, lobectomy is enough in a select group of low-risk patients with intrathyroidal well-differentiated thyroid cancer.

After the publication of the American Thyroid Association guidelines in 2006 and revised guidelines in 2009,[1] the debate with regard to the extent of thyroid surgery for well-differentiated thyroid carcinoma seemed to have ended. There was a strong reference in the American Thyroid Association guidelines to a publication