Original Article

The Role of Clinicians in Determining Radioactive Iodine Use for Low-Risk Thyroid Cancer

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BACKGROUND: There is controversy regarding the optimal management of thyroid cancer. The proportion of patients with low-risk thyroid cancer who received radioactive iodine (RAI) treatment increased over the last 20 years, and little is known about the role played by clinicians in hospital-level RAI use for low-risk disease. **METHODS:** Thyroid surgeons affiliated with 368 hospitals that had Commission on Cancer-accredited cancer programs were surveyed. Survey data were linked to data reported to the National Cancer Database. A multivariable analysis was used to assess the relation between clinician decision makers and hospital-level RAI use after total thyroidectomy in patients with stage I, well differentiated thyroid cancer. **RESULTS:** The survey response rate was 70% (560 of 804 surgeons). The surgeon was identified as the primary decision maker by 16% of the surgeons; the endocrinologist was identified as the primary decision maker by 69%, and a nuclear medicine, radiologist, or other physician was identified as the primary decision maker by 15%. In a multivariable analysis controlling for hospital case volume and hospital type, when the primary decision maker was in a specialty other than endocrinology or surgery, there was greater use of RAI at the hospital ($P < .001$). A greater number of providers at the hospital where RAI was administered and having access to a tumor board also were associated with increased use of RAI ($P < .001$ and $P = .006$, respectively). **CONCLUSIONS:** The specialty of the primary decision maker, the number of providers administering RAI, and having access to a tumor board were associated significantly with the use of RAI for stage I thyroid cancer. The findings have implications for addressing nonclinical variation between hospitals, with a marked heterogeneity in decision making suggesting that standardization of care will be challenging. ***Cancer*** **2013;119:259-65.** © *2012 American Cancer Society.*

KEYWORDS: thyroid cancer, radioactive iodine, physician, decision making.

INTRODUCTION

Thyroid cancer is a common malignancy with a persistently rising incidence rate.[1,2] In contrast to many other common malignancies, there is great controversy the over standard of care for thyroid cancer.[3,4] In the setting of this ongoing dispute, over the last 20 years, there has been an increase in the use of radioactive iodine (RAI) after total thyroidectomy as treatment for low-risk thyroid cancer.[5,6] The benefit of using RAI to treat low-risk disease is unclear,[7-10] and this increase in the use of RAI has potential implications for patient health and health care costs. Treatment with RAI is associated with increased risk of second primary malignancy and damage to salivary glands and lacrimal ducts.[6,11,12] In addition, there are clear cost-saving benefits when RAI is not administered to patients with low-risk disease.[13]

Although it is known that there is marked hospital-level variation in the use of RAI, with the most variation observed in low-risk patients,[5] the role of surgeons, endocrinologists, and nuclear medicine physicians in RAI use and in the inter-hospital variation in its use is unknown. It is not clear whether the number and specialty of the providers involved in the decision-making process influence the use of RAI at the hospital level.

By linking surgeon surveys to data from the National Cancer Database (NCDB), we were able to obtain details on providers and RAI use that would not otherwise be available. The objective of the current study was to assess the role of clinicians in hospital-level use of RAI for the treatment of patients with American Joint Committee on Cancer stage I, well differentiated thyroid cancer.

MATERIALS AND METHODS

Data Source and Study Population

We selected the 1159 hospitals with Commission on Cancer-accredited cancer programs that reported having treated thyroid cancer to the National Cancer Database (NCDB), a joint project of the American College of Surgeons and the

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American Cancer Society, in at least 4 of the 5 years between 2004 and 2008. We excluded the 235 hospitals that treated fewer than 6 thyroid cancer patients a year. We divided the remaining hospitals by quartiles of hospital case volume and then by quartiles of RAI use. We randomly sampled 589 hospitals across these quartiles. Then, we contacted the hospital registrars and searched hospital web sites to identify the surgeons who performed the majority of thyroid surgeries at each hospital. We identified 850 thyroid surgeons.

We used a modified Dillman method of survey administration[14] when surveying the 850 surgeons. This method consists of 3 waves of mailings with a gift included with the first mailing.

Survey data were deidentified, scanned, and confirmed. The surgeon survey responses were linked to details on hospital case volume and hospital use of RAI from the NCDB, which captures close to 85% of all thyroid cancer cases in the United States.[15] When treatment postsurgery does not occur at the specified hospital, the hospital registrar is responsible for documenting the remainder of the patients' disease course and treatment.[16] Because patients do not typically receive RAI after undergoing thyroid lobectomy, and because RAI is not recommended in the treatment of medullary or anaplastic cancer, we selected hospital treatment with RAI in patients who underwent total thyroidectomy and had American Joint Committee on Cancer stage I, well differentiated thyroid cancer (papillary, follicular, and Hurthle cell types).

All surveys were deidentified, as described above, and data were analyzed in summary form only. Exemption was granted by the University of Michigan Institutional Review Board.

Measures

The survey was designed to collect key information about thyroid cancer management through use of clinical vignettes and survey questions (including 5-point and 6-point Likert scales). Before survey administration, we piloted our survey instrument in a diverse group of surgeons.

The dependent variable, use of RAI in stage I thyroid cancer, and 1 independent variable, hospital case volume, were obtained from the NCDB. There were 4 categories for hospital case volume: low (7-11 thyroid cancer cases per year), low-moderate (12-19 thyroid cancer cases per year), moderate (20-34 thyroid cancer cases per year), and high ($\geq$35 thyroid cancer cases per year). The data from the NCDB were then linked to the deidentified surgeon surveys affiliated with the specified hospitals. The remaining independent variables (number of providers involved in decision making, number of providers administering RAI, access to a tumor board, frequency of tumor board meetings, same-day visits with other providers, primary decision maker on RAI use, primary decision maker on RAI dose, primary provider to administer RAI, surgeon involvement in decision making) were obtained from surgeon surveys, as indicated in Figure 1. Because surgeons could choose more than 1 practice setting, when more than 1 practice setting was selected, we applied an algorithm previously described by Alderman et al.[17] If they selected an academic tertiary care center (even if they also selected a community affiliate or private practice), then the assigned practice setting was academic. If they chose both community-based academic affiliate and private practice, then the assigned practice setting was community.

Statistical Analyses

When more than 1 surgeon responded from the same hospital, the surgeon responses were weighted according to the reported case volume. Surgeon case volume was categorized as 1, 5, 25, 50, 100 using the lower limits of the corresponding response intervals to a survey item that specifically asked how many patients with thyroid cancer the surgeon operated on in 1 year (for the 0-4 interval, the surgeon was assigned a value of 1).

We evaluated the hospital-level use of RAI across all independent variables. We then included the decision-making variables that were significant on univariate analysis in a multivariable regression model adjusted for hospital case volume and surgeon-reported practice setting (academic tertiary care, community-based academic affiliate, and private practice). Two-way interactions were evaluated.

We also determined the distribution of patients according to tumor size ($\leq$1.0 cm, 1.1-2.0 cm, 2.1-4.0 cm, and $>$4.0 cm) and lymph node status (N0, N1, NX) within the hospitals based on the 3 categories of physician decision makers (surgeon, endocrinologist, and nuclear medicine/radiology/other), access to a tumor board, and number of providers administering RAI.

All statistical tests were performed using the SAS statistical software package (version 9.2; SAS Institute Inc., Cary, NC). Two-sided tests were used, and P values $< .05$ were considered statistically significant.

RESULTS

Sample Characteristics

Figure 2 indicates that 46 of the 850 surgeons were ineligible for the study. Of the 804 response-eligible surgeons,

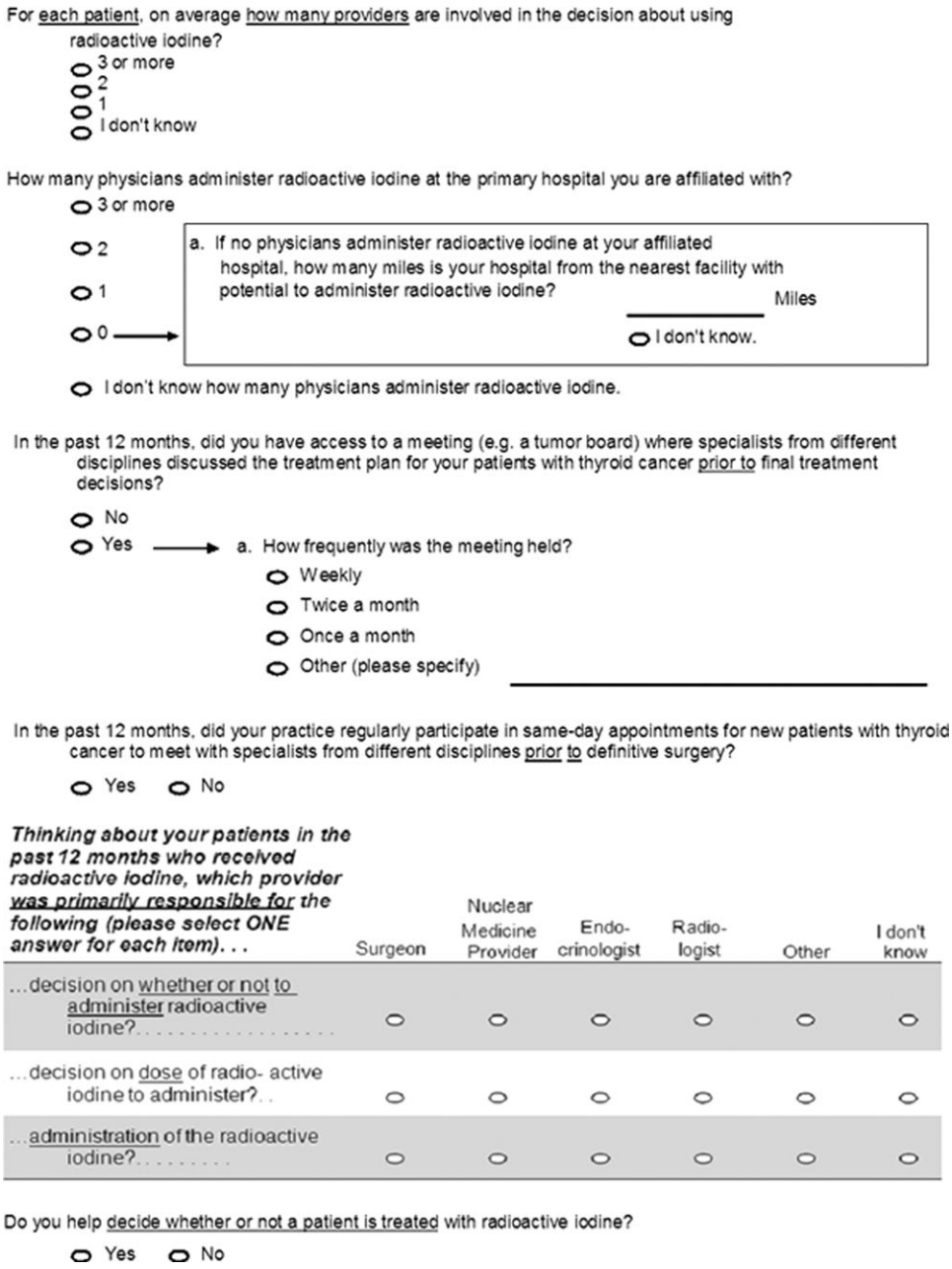

Figure 1. Some items from the surgeon survey are shown.

560 (70%) completed the survey. The majority of respondents (90%) were men, and they had an average of 19 ± 10 years in practice. Otolaryngologists (44%) were the largest surgical specialists represented, followed by general surgeons (39%), then endocrine surgeons (9%), and other surgeon specialists (8%). Most surgeons (61%) were in private practice, but 23% worked in an academic setting, and 16% were employed by a community-based academic affiliate.

Impact of Providers on Use of Radioactive Iodine

Univariate analyses

The majority of surgeons (63%) reported that 2 providers were involved in the RAI decision-making process, and 74% of surgeons reported their personal involvement, as indicted in Table 1. Three or more providers administered RAI at 46% of the affiliated hospitals. In univariate analysis, there was a strong association between the

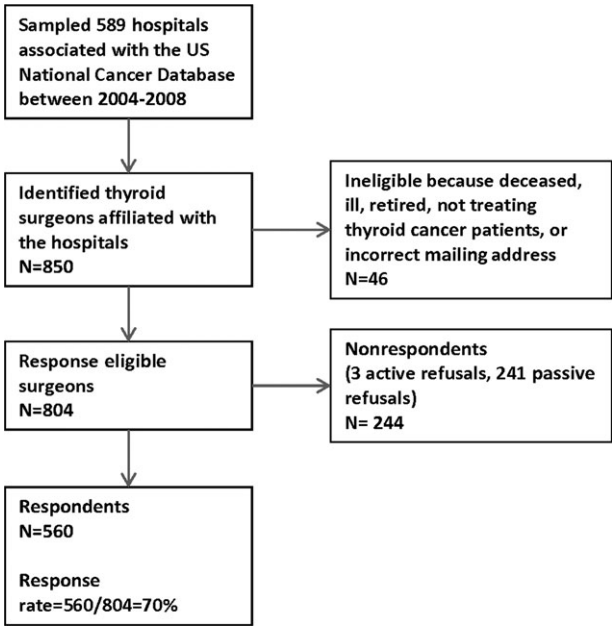

Figure 2. The sampling method and patient flow are illustrated.

number of providers administering RAI and the likelihood of a patient with stage I thyroid cancer receiving RAI at the hospital level ($P < .001$). Access to a tumor board also was associated with a greater likelihood of receiving RAI, but the frequency of the tumor board meeting or same-day appointments with specialists from different disciplines did not have an impact on receipt. Endocrinologists more often were the primary decision maker on whether or not to administer RAI (69%), but nuclear medicine/radiology/other providers more frequently were the primary decision makers regarding RAI dose (54%) and most often were the providers responsible for administering RAI (69%). Specialty of the primary decision maker on whether or not to administer RAI was associated with an increased likelihood that a patient with stage I thyroid cancer would receive RAI ($P = .004$). If a surgeon was the primary decision maker, then a mean of 42% of patients received RAI for stage I disease; and, if the endocrinologist was the primary decision maker, then a mean of 45% of patients received RAI. When a nuclear medicine provider/radiologist/other was the primary decision maker, then the proportion was higher, and a mean of 52% patients received RAI. There was no significant association between the proportion of patients receiving RAI at the hospital and the specialty of the primary decision maker on dose or specialty of the administering provider.

The proportion of patients within each tumor size category ($\leq$1.0 cm, 1.1-2.0 cm, 2.1-4.0 cm, and $>$4.0 cm) was the same when the primary decision maker was a surgeon versus an endocrinologist versus a nuclear medicine/radiology/other physician. Similarly, among the patients affiliated with hospitals where nuclear medicine/radiologist/other physicians were the primary decision makers, 88% were without lymph node metastases versus 87% of the patients affiliated with hospitals where surgeons or endocrinologists were the primary decision makers. The distribution according to both tumor size and lymph node status was almost identical in hospitals that had access to a tumor board versus no access. Similarly, there were very similar distributions according to tumor size and lymph node status in hospitals that had 1, 2, and 3 physicians administering RAI. However, not having a provider administer RAI at the affiliated hospital was associated with a lower proportion of tumors $\leq$1.0 cm (20% vs 24%) and with a higher proportion of N0 cancers (89% vs 86%) compared with hospitals that had $\geq$3 providers administering RAI.

Multivariable analysis

In multivariable analysis, high case volume, private practice, and access to a tumor board were associated with a statistically greater likelihood that a patient with stage I thyroid cancer would receive RAI (Table 2). There was also a significant difference in the proportion of patients that received RAI if no provider ($P < .001$) or 1 provider ($P = .010$) at the hospital administered RAI versus $\geq$3 providers administering RAI. There was no statistically significant difference in hospital-level RAI use when 2 providers versus 3 providers administered RAI. However, when nuclear medicine/radiology/other providers were the primary decision makers on whether or not to administer RAI, a significantly higher proportion of patients with stage I thyroid cancer received RAI at the hospital than if the decision maker was a surgeon ($P < .001$) or an endocrinologist ($P < .001$) (Table 2, Fig. 3). There was a statistically significant interaction between the primary decision maker and the number of providers administering RAI ($P = .020$). Having just 1 provider administering RAI at the hospital was associated with a nuclear medicine/radiologist/other provider not being the primary decision maker. There was no interaction with access to a tumor board.

DISCUSSION

The current study demonstrates heterogeneous treatment processes in the care of patients with well differentiated

Table 1. Univariate Analysis of Clinician Decision Making and Radioactive Iodine Use

Variable	No. of Patients (%)	Proportion of Patients That Received RAI at Hospital: Mean±SD, %	*P*
No. of providers involved in decision making about use of RAI			.201
≥3	105 (20)	47.88±19	
2	332 (63)	45.86±21.35	
1	90 (17)	42.48±22.52	
No. of providers administering RAI			< .001
≥3	240 (46)	47.47±19.21	
2	143 (27)	48.76±19.46	
1	102 (20)	44.55±25.01	
0	36 (7)	29.28±22.63	
Access to tumor board			.011
Yes	395 (71)	47.54±20.50	
No	158 (29)	42.55±22.04	
Frequency of tumor board			.188
Weekly	166 (42)	49.42±19.61	
Twice a month	73 (19)	48.15±19.14	
Once a month	134 (34)	44.31±22.57	
Other	20 (5)	45.91±20.22	
Same-day visits with other providers			.791
Yes	110 (20)	45.46±19.66	
No	446 (80)	46.06±21.55	
Primary decision maker on whether or not to administer RAI			.004
Surgeon	87 (16)	42.29±21.57	
Endocrinologist	374 (69)	45.42±20.37	
NM/radiol/other	83 (15)	52.50±23.05	
Primary decision maker on dose of RAI			.894
Surgeon	4 (1)	41.22±18.63	
Endocrinologist	232 (45)	46.27±20.26	
NM/radiol/other	282 (54)	46.14±21.91	
Primarily administers RAI			.192
Surgeon	0 (0)		
Endocrinologist	165 (31)	44.18±21.72	
NM/radiol/other	361 (69)	46.80±21.22	
Surgeon involved in RAI decision making			.591
Yes	414 (74)	45.73±21.20	
No	143 (26)	46.83±21.07	

Abbreviations: NM, nuclear medicine provider; radiol, radiologist; RAI, radioactive iodine; SD, standard deviation.

thyroid cancer. The number and type of providers involved in decision making varied by hospital. Controlling for hospital case volume and hospital type, we observed that the specialty of the primary physician decision maker, the number of providers administering RAI, and having access to a tumor board influenced the use of RAI for stage I thyroid cancer.

Similar to studies in other disease states illustrating the relation between access to care and treatment,[18-21] if there are more providers administering RAI or if there is access to a tumor board, then the likelihood of treatment with RAI increases. This difference is most marked when there is not a provider at the affiliated hospital that administers RAI (29% vs 47% of patients receiving RAI; $P < .001$), and it also is observed when there is only 1 administering provider instead of ≥3 providers. Thus, both lack of access and supply-demand may influence receipt of RAI.

In the treatment of other malignancies, it is known that cancer specialists are more likely to recommend the treatments their specialty provides.[22,23] Although the current study is novel, because the focus is thyroid cancer management and the details provided by surgeon surveys are linked to hospital-level use, some of the findings parallel what has been reported in other malignancies.[22,23] The majority of surgeons (69%) reported that nuclear

Table 2. Multivariable Analysis of Radioactive Iodine Use for Stage I Thyroid Cancer

Variable	Proportion of Patients That Received RAI at Hospital: Mean±SD, %	Multivariable *P*
Hospital characteristics		
Case volume		
Low	40.13±25.66	.002
Low-moderate	48.63±21.97	.518
Moderate	44.29±20.14	.075
High	48.48±17.75	Ref
Practice setting		
Academic	44.91±17.34	Ref
Community-based academic affiliate	44.09±19.52	.715
Private	46.48±22.92	.036
Decision-making process		
Access to tumor board		
Yes	47.57±20.50	.006
No	42.55±22.04	Ref
No. of providers administering RAI		
≥3	47.47±19.21	Ref
2	48.76±19.46	.694
1	44.55±25.01	.010
0	29.28±22.63	< .001
Primary decision maker on whether or not to administer RAI		
Surgeon	42.29±21.57	< .001
Endocrinologist	45.42±20.37	< .001
NM/radiol/other	52.50±23.05	Ref

Abbreviations: NM, nuclear medicine provider; radiol, radiologist; RAI, radioactive iodine; Ref, referent category; SD, standard deviation.

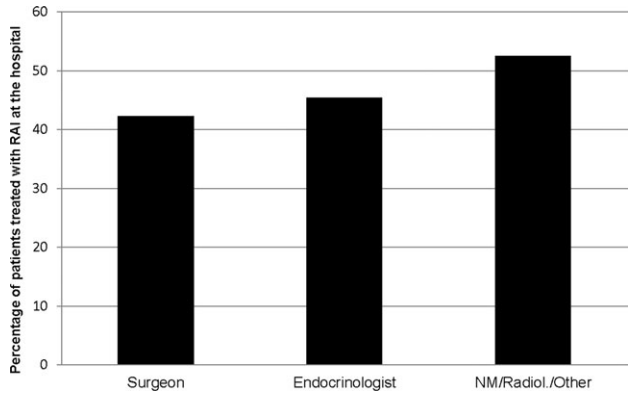

Figure 3. The proportion of patients with American Joint Committee on Cancer (AJCC) stage I thyroid cancer who received radioactive iodine (RAI) is illustrated according to the specialty of the primary decision maker. When the primary decision maker on whether or not to administer RAI was a nuclear medicine (NM), radiology (Radiol), or other provider, a greater proportion of patients with AJCC stage I thyroid cancer received RAI at the hospital than if the primary decision maker was a surgeon ($P < .001$) or an endocrinologist ($P < .001$).

medicine/radiology/other providers administered RAI. When these specialists acted as the primary decision makers with respect to the use of RAI, there was greater hospital-level use of RAI in stage I disease (52% vs 42%-45%; $P < .001$). Specialty differences in administration rates may be related to differences in training, variable adherence to clinical guidelines, various views on risks/benefits, or the influence of financial incentives. Previous studies have demonstrated the role of financial incentives in influencing cancer care.[24,25]

Although regional differences in physician opinion about RAI use after total thyroidectomy were evaluated previously,[26] and variation in interspecialty opinion on postoperative management has been noted,[27] to our knowledge, this is the first study to evaluate the characteristics of decision making, including specialty of the primary decision maker, with respect to hospital-level RAI use. Strengths of this study include a large sample size, a high response rate, an exhaustive set of independent variables, and reliable information on the use of RAI at the hospital level. Despite the strengths of this study, there are limitations. First, similar to other survey studies, there is a risk of nonresponse selection bias. Second, several of the independent variables are based on surgeon report. However, it has been demonstrated that surgeon report is accurate in terms of surgical volume,[17] and surgeon self-report is commonly used to report other cancer care processes.[17,23,28,29] Finally, we cannot control for the selection of patients to hospitals. In an attempt to assess the influence of patient selection to hospitals, we determined the distribution of patients according to tumor size and lymph node status. However, these measures are imperfect, because hospital use of imaging studies may have an impact on the distribution of cancers based on size, and hospital use of prophylactic lymph node dissections may affect the proportion of patients with known lymph node metastases.

In conclusion, although we did not specifically evaluate the appropriateness of using RAI, the current study sheds light on the role of clinicians in the wide variation in RAI use for low-risk thyroid cancer. In addition to previously described patient and hospital characteristics,[5] it appears that providers influence RAI use. The current results also illustrate the heterogeneity of clinician decision making in thyroid cancer management, which reflects the complexity of multidisciplinary care. This heterogeneity suggests that standardization of thyroid cancer care will be challenging. These findings have implications for targeted clinical guideline dissemination, future studies on thyroid cancer management, and, most important, patient care.

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CONFLICT OF INTEREST DISCLOSURES

The authors made no disclosures.

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