

RESEARCH

A national survey of physicians regarding active surveillance for low-risk thyroid cancer in Korea

Min Joo Kim^{1,2}, Jae Hoon Moon^{1,2}, Eun Kyung Lee³, Young Shin Song⁴, Kyong Yeun Jung⁵, Ji Ye Lee^{6,7}, Ji-hoon Kim^{6,7}, Woojin Lim^{8,9,10}, Kyungsik Kim^{8,9}, Sue K. Park^{8,9,11} and Young Joo Park¹²

¹Department of Internal Medicine, Seoul National University Bundang Hospital, Seongnam, Republic of Korea

²Department of Internal Medicine, Seoul National University College of Medicine, Seoul, Republic of Korea

³Department of Internal Medicine, National Cancer Center, Goyang, Republic of Korea

⁴Department of Internal Medicine, Seoul National University Boramae Medical Center, Seoul, Republic of Korea

⁵Department of Internal Medicine, Nowon Eulji Medical Center, Eulji University, Seoul, Republic of Korea

⁶Department of Radiology, Seoul National University Hospital, Seoul, Republic of Korea

⁷Department of Radiology, Seoul National University College of Medicine, Seoul, Republic of Korea

⁸Department of Preventive Medicine, Seoul National University College of Medicine, Seoul, Republic of Korea

⁹Cancer Research Institute, Seoul National University College of Medicine, Seoul, Republic of Korea

¹⁰Department of Biomedical Sciences, Seoul National University Graduate School, Seoul, Republic of Korea

¹¹Integrated Major in Innovative Medical Science, Seoul National University College of Medicine, Seoul, Republic of Korea

¹²Department of Molecular Medicine and Biopharmaceutical Sciences, Graduate School of Convergence Science and Technology, Seoul National University, Seoul, Republic of Korea

Correspondence should be addressed to Y J Park: yjparkmd@snu.ac.kr

Abstract

Objective: Active surveillance (AS) has emerged as a viable alternative to immediate surgery for low-risk thyroid cancer. However, several barriers still hinder its widespread adoption and implementation by physicians.

Methods: In 2024, an email survey was conducted among members of the Korea Thyroid Association to assess their perspectives on AS. The survey comprised questions about clinical case scenarios, perceptions of the benefits and risks associated with AS, factors influencing the consideration of AS and unmet needs for the implementation of AS.

Results: Among the 287 physicians surveyed, 40.8% were endocrinologists, followed by general surgeons at 20.9% and otolaryngologists at 19.9%. The majority worked in tertiary hospitals and had over 10 years of experience. Regarding a 65-year-old man with a 0.7 cm low-risk thyroid cancer, 74.6% of the respondents considered AS. Endocrinologists and physicians with higher self-assessment and experience explaining AS to patients were more inclined to consider AS. Although the respondents recognized the benefits of AS, such as avoiding surgery and reducing surgical complications, they expressed concerns about potential risks, including the possibility of patient lawsuits due to disease progression and patient worry and anxiety about the disease. Challenges in screening candidates for AS were highlighted, especially in detecting recurrent laryngeal nerve involvement and lymph node metastases. Additionally, physicians noted unmet needs in AS implementation, specifically regarding psychological support for patients and reimbursement for long-term follow-up costs.

Conclusions: The survey underscored the need for further research and initiatives to overcome the barriers and implement AS for the management of low-risk thyroid cancer.

Keywords: active surveillance; papillary thyroid cancer; survey; thyroidectomy; watchful waiting

Introduction

Thyroid cancer is one of the most common cancers (1). In particular, South Korea has the highest incidence rate of thyroid cancer in the world. According to a 2020 report, the age-standardized incidence rate of thyroid cancer in women was 17.4 per 100,000 people in the United States (US), while it was 44.6 per 100,000 people in South Korea (1). The incidence of thyroid cancer increased rapidly in the early 2000s with the widespread use of ultrasound (2). In South Korea, the incidence of thyroid cancer also increased abruptly in the early 2000s, but the mortality rate from thyroid cancer did not increase (3). In addition, there is a strong association between thyroid cancer screening by ultrasound and the incidence rate of thyroid cancer (3). This makes South Korea an epicenter of the controversy over overdiagnosis of thyroid cancer.

Amid ongoing controversy, active surveillance (AS) has emerged as a viable alternative approach to managing low-risk thyroid cancer. Previously, surgery was the only treatment option available for this condition. However, it is now recognized that AS for low-risk thyroid cancer may not significantly alter outcomes or prognosis compared with immediate surgery (4). No deaths have been reported during AS, with tumor growth occurring in only 2.2–10.8% of cases and lymph node (LN) metastasis observed in 0–1.4% of cases (4, 5). The 2015 American Thyroid Association (ATA) guidelines suggested that AS could be considered for papillary thyroid microcarcinoma (PTMC) measuring 1 cm or less, without clinically evident metastases or local invasion (6). Subsequently, guidelines from various countries have also endorsed AS as an alternative approach for low-risk thyroid cancer (7). As a result, AS has gained widespread acceptance.

However, the appropriate treatment plan for patients with low-risk thyroid cancer is complex and multifaceted. In situations where AS is a viable option, it is crucial for physicians to involve patients in detailed discussions about the choices between surgery and AS, promoting shared decision making (8, 9). These discussions should consider tumor characteristics such as its size and location, patient characteristics including age, comorbidities, and personal preferences and medical team characteristics (7, 10). Guiding patients in choosing AS presents a significant challenge for physicians.

Surveys have been conducted among physicians regarding low-risk treatment strategies, including AS (11, 12, 13, 14). However, most of these surveys were conducted in the US around 2017–2018. In Korea, AS was first introduced in the 2016 Korea Thyroid Association (KTA) guidelines, and since then,

research on AS has been actively carried out (7). In the 2023 and 2024 KTA guidelines, AS is also conditionally recommended for adult patients with low-risk PTMC (15, 16). Korea is among the countries where AS has gained widespread acceptance. A survey was conducted to evaluate the barriers, facilitators and unmet needs that Korean physicians encounter when implementing AS for low-risk thyroid cancer.

Materials and methods

Study population

A survey was conducted among the members of the KTA, a group of physicians specializing in thyroid cancer treatment. This society included specialists such as internists (endocrinologists), general surgeons (endocrine surgeons), otolaryngologists (head and neck surgeons), radiologists, nuclear medicine physicians and pathologists. The survey link was emailed to the members. The study received approval from the Seoul National University Hospital Institutional Review Board (H-2311-143-1487) and was exempt from the requirement for written consent.

The survey was conducted in January 2024, and to enhance response rates, two reminder emails were sent following the initial invitation. An email was dispatched to all 3220 physician members who have registered online with the KTA since its inception in 2008. Out of these, 287 (8.9%) physicians responded. However, in 2022 and 2023, an average of 376 (313–451) physicians attended the biannual KTA conferences. Given this attendance, approximately 76% of actively participating members responded.

Instrument development

The survey was developed by three endocrinologists and reviewed by the KTA. It consisted of six main sections. i) Demographics and characteristics (11 questions): this section collected information about the respondents, including age, sex, type of affiliated hospital, specialty, clinical experience, self-assessment and experience explaining AS. To assess the level of clinical experience, participants were asked to indicate the number of years since becoming a specialist by choosing from the following options: less than 5 years, 5–9 years or more than 10 years. To assess the participants' self-assessment, they were asked, 'How would you rate your level of knowledge and understanding of AS in the treatment of thyroid cancer?' with the response options of very poor, poor,

somewhat poor, fair, good and very good. Participants were asked, 'Have you ever explained AS to a patient with low-risk thyroid cancer?' with the response options of yes or no. ii) Clinical cases (two questions): respondents were presented with two patient scenarios and asked about their consideration of AS. Responses were categorized into five options: definitely consider, probably consider, probably not consider and definitely not consider. iii) Potential benefits of AS (six questions): respondents were presented with a list of expected benefits and asked to give their opinion on each. Responses were divided into three categories: great benefit, some benefit and no benefit. iv) Potential risks of AS (11 questions): expected risks were listed, and responses were categorized into three levels of concern: very concerned, somewhat concerned and not concerned. v) Factors that make it difficult to screen patients for AS (nine questions): factors considered when selecting patients for AS were listed, and responses were categorized into three levels of difficulty: very difficult, somewhat difficult and not difficult. vi) Unmet needs for implementing AS (seven questions): expected needs for implementing AS were listed, and responses were divided into two categories: insufficient and sufficient.

Statistical analysis

Physician demographics and responses were summarized using numbers and percentages. Response frequencies and distributions were compared across each question. Logistic regression analyses were conducted to explore factors influencing physicians' decisions for each patient case. All statistical analyses were performed using SAS software version 9.4 (SAS Institute Inc., USA) and SPSS version 27.0 for Windows (IBM Corp., USA).

Results

Demographics of the respondents

A total of 287 physicians participated in the survey, with their demographics detailed in Table 1. The largest age group was 40–49 years, comprising 41.1% of respondents, and 63.4% were male. The majority, 57.5%, were employed at tertiary hospitals. They represented all regions of Korea, predominantly from Seoul and Gyeonggi province. Endocrinologists made up 40.8%, followed by general surgeons at 20.9% and otolaryngologists at 19.9%. Additionally, 65.2% of the respondents had over 10 years of professional experience. Regarding their knowledge and understanding of AS, 54.7% rated it as good or very good. Of these, 73.9% had experience explaining AS to patients.

Table 1 Selected characteristics of physicians ($n = 287$) who participated in the survey. Data are presented as n (%).

Characteristics	Values
Age, years	
≤ 39	73 (25.5%)
40–49	118 (41.1%)
50–59	77 (26.8%)
>60	19 (6.6%)
Sex	
Men	182 (63.4%)
Women	105 (36.6%)
Hospital type	
Tertiary hospital	165 (57.5%)
General hospital	73 (25.4%)
Hospital, clinic	49 (17.1%)
Location	
Seoul	116 (40.4%)
Gyeonggi-do	45 (15.7%)
Others	126 (43.9%)
Specialty	
Internal medicine	117 (40.8%)
General surgery	60 (20.9%)
Otolaryngology	57 (19.9%)
Others	53 (18.4%)
Years of experience	
≥ 10	187 (65.2%)
5–9	52 (18.1%)
<5	48 (16.7%)
Self-assessment	
Good or very good	157 (54.7%)
Somewhat poor or fair	109 (38.0%)
Very poor or poor	21 (7.3%)
Experience of explanation	
Yes	212 (73.9%)
No	75 (26.1%)

Physicians' preferences and influencing factors

Two cases were presented, and respondents were asked if they would consider AS. In the first case, involving a 65-year-old man with a 0.7 cm thyroid cancer without extrathyroidal extension and LN metastasis, 74.6% of respondents indicated that they would consider AS (Fig. 1A). To identify the factors influencing the physicians' decisions, logistic regression analysis was conducted (Fig. 1B). Endocrinologists were more likely to recommend AS than general surgeons or otolaryngologists (odds ratio (OR): 2.836, 95% confidence interval (CI): 1.360–5.916, $P = 0.006$). Physicians with higher self-assessment were also more inclined to consider AS (OR: 5.587, 95% CI: 2.115–14.757, $P = 0.001$). Similarly, those with experience in explaining AS were more likely to consider AS (OR: 6.233, 95% CI: 3.450–11.260, $P < 0.001$). However, no differences were observed based on the hospital type or the length of clinical experience. In the second case, concerning a 45-year-old woman with a 1.0 cm thyroid cancer without extrathyroidal extension and LN metastasis,

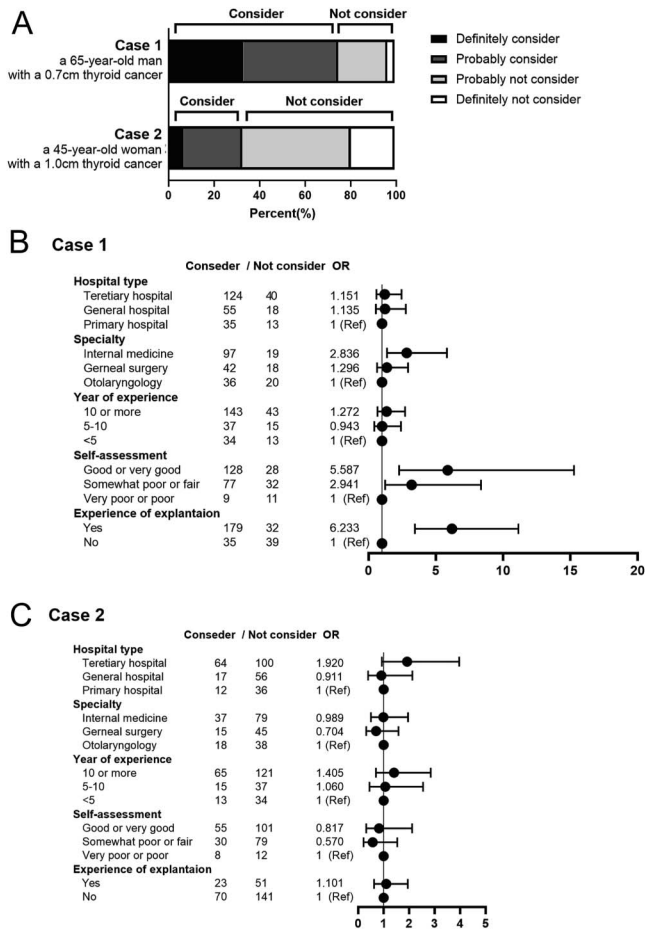


Figure 1

Physicians' responses regarding active surveillance (AS). (A) Physicians' responses about whether they would consider AS in each case. (B) Factors associated with physicians' decisions in case 1. (C) Factors associated with the physicians' decisions in case 2. Responses of 'definitely consider' and 'probably consider' were categorized as 'consider', while 'probably not consider' and 'definitely not consider' were categorized as 'not consider'. Logistic regression analysis was then performed, and an odds ratio > 1 indicates a higher likelihood of considering AS.

only 32.4% of respondents said they would consider AS (Fig. 1A). A logistic regression analysis to determine the factors associated with the physicians' decision in this second case was performed, but it yielded no significant results (Fig. 1C). The consideration of AS did not vary by hospital type, physician specialty, years of experience, self-assessment or experience in explaining AS.

Physicians' perspectives on the potential benefits of AS

When asked about the potential benefits of AS (Fig. 2), respondents indicated that the primary advantages

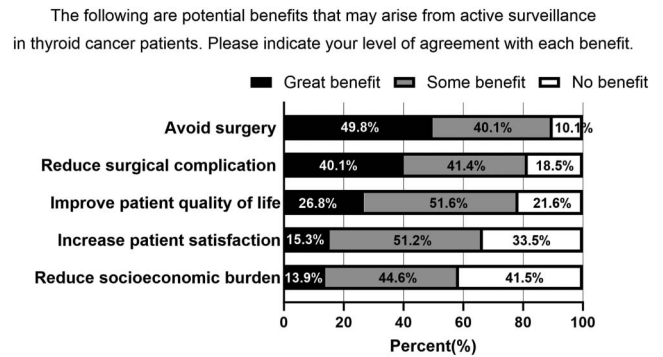


Figure 2

Physicians' perspectives on the potential benefits of active surveillance.

included avoiding surgery (49.8%) and reducing surgical complications (40.1%). Additionally, they noted an improved quality of life for patients (26.8%) as another significant benefit of AS. Physicians who assessed their own understanding of AS highly were more likely to view avoiding surgery as a great benefit (Supplementary Table S1 (see the section on Supplementary materials given at the end of the article)). Similarly, physicians experienced in explaining AS to patients recognized the avoidance of surgery and the reduction of surgical complications as a great benefit (Supplementary Table S1).

Physicians' perspectives on the potential risks of AS

When asked about the potential risks of AS (Fig. 3), physicians expressed significant concerns. The primary concern was the risk of patient lawsuits resulting from disease progression, cited by 36.6% of respondents. Additionally, 26.8% of physicians were concerned about the patient's worry and anxiety related to the disease. Concerns were also raised about the possibility of needing to expand surgical interventions or administer additional radioactive iodine therapy because of disease progression, which was noted by 24.7% of respondents, and the subsequent increase in treatment complications, mentioned by 19.8%. Physicians also highlighted the increased consultation time required to explain AS, which concerned 22.0% of respondents. Furthermore, 19.1% were worried about the patient burden due to long-term follow-up, and 18.8% were concerned about the increase in social healthcare costs. Overall, physicians with 10 or more years of experience, those with good self-assessment and those experienced in explaining AS reported significantly fewer concerns about the potential risks associated with AS (Supplementary Table S2). Additionally, physicians working in tertiary

The following are potential risks that may occur during active surveillance in thyroid cancer patients. Please indicate your level of concern for each risk.

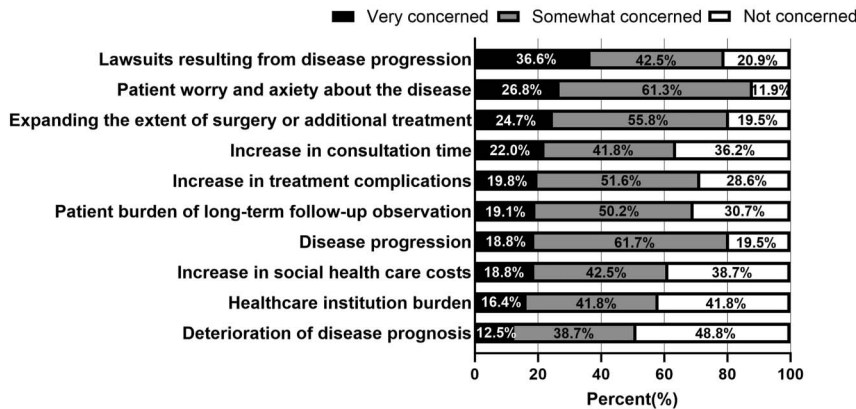


Figure 3 Physicians' perspectives on the potential risks of active surveillance.

hospitals showed significantly less concern about lawsuits resulting from disease progression.

Factors making patient screening for AS difficult

We identified factors that made it difficult to screen patients for AS (Fig. 4). Physicians reported significant challenges in detecting recurrent laryngeal nerve (RLN) involvement (27.2%) and LN metastasis (20.6%) using ultrasound. Additionally, they found it challenging to ascertain a patient's preference for AS (16.7%). Generally, physicians with over 10 years of experience, those with good self-assessment and those experienced in explaining AS had significantly less difficulty in screening suitable patients for AS (Supplementary Table S3). Moreover, endocrinologists reported more difficulty in identifying RLN involvement or LN metastasis compared with otolaryngologists (Supplementary Table S3).

The following are factors that make it difficult to select appropriate thyroid cancer patients for active surveillance. Please indicate the level of difficulty based on your experience.

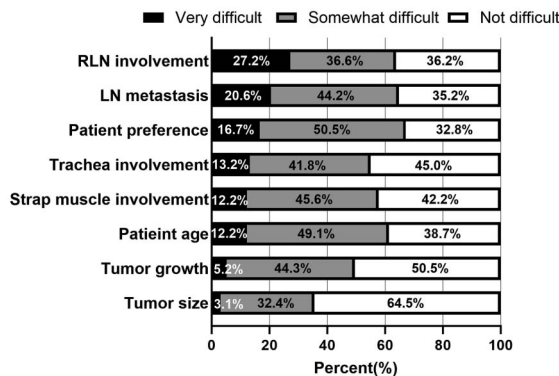


Figure 4 Challenges to screening appropriate patients for active surveillance.

Unmet needs for implementing AS

When physicians were surveyed about the informational resources and support they felt were lacking in the implementation of AS for low-risk thyroid cancer patients (Fig. 5), the majority reported a need for psychological support to manage patient anxiety (88.9%) and reimbursement to reduce costs associated with long-term follow-up (88.5%). Additionally, 85.7% indicated a lack of information or educational materials on AS to share with patients, and 83.6% noted an insufficiency in cost-effectiveness data for AS. These needs were more pronounced than the need for guidelines and protocols for AS (73.5%) and criteria for selecting patients for AS (60.6%). The guidelines and protocols for AS, and patient selection criteria for AS, were significantly greater among physicians with poor self-assessment and physicians without experience in explaining AS (Supplementary Table S4).

Discussion

Although many guidelines recommend AS (7), it remains unclear how widely physicians have adopted it and

The following are information or support needed when conducting active surveillance in thyroid cancer patients. Please indicate what is currently lacking.

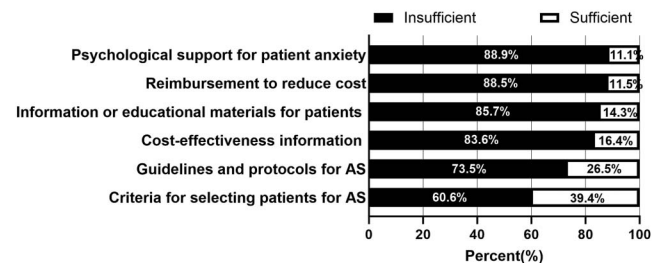


Figure 5 Unmet needs for active surveillance.

what challenges they face in its implementation. This study revealed that a significant number of Korean physicians view AS as a viable alternative approach to low-risk thyroid cancer. Endocrinologists, as well as physicians who possess greater self-assessment and experience explaining AS, were more inclined to consider it. Physicians identified the avoidance of surgery and its complications as potential advantages of AS. However, they also highlighted several concerns including the risk of patient lawsuits due to disease progression and patient worry and anxiety about the disease. There is still a perceived lack of information and support for implementing AS in the management of low-risk thyroid cancer.

This study represents the first survey conducted in Korea to explore treatment strategies for low-risk thyroid cancer. In this survey, 74.6% of physicians indicated they would consider AS for a 65-year-old man with a 0.7 cm thyroid cancer without extrathyroidal extension and LN metastasis (case 1). This percentage is significantly higher than that of a similar survey conducted in the US during 2017–2018. In a 2017 survey by the ATA, the American Association of Endocrine Surgeons (AAES) and the American Head and Neck Society (AHNS), only one-third of physicians recommended AS for a 75-year-old woman with a 0.8 cm thyroid cancer (17). In a 2018 survey by the American Medical Association (AMA), only 11.4% of physicians chose AS for a 45-year-old woman with a 0.8 cm thyroid cancer (13). This trend suggests that AS has become a more established approach to thyroid cancer over time. However, for a 45-year-old woman with a 1.0 cm thyroid cancer (case 2), only one-third of the physicians considered AS, indicating ongoing challenges in the clinical implementation of AS. It is well known that the likelihood of disease progression in PTMC during AS increases with age (18, 19, 20, 21). Therefore, while AS is possible for adults of all ages, it is considered ideal for those aged 60 years and older (10, 15). In addition, a larger tumor size is associated with a higher risk of disease progression in PTMC during AS (20, 21). As a result, the proportion of physicians considering AS was significantly lower in case 2, which was a younger patient with a larger tumor, compared with case 1 (11.4 vs 74.6%).

Physicians' preferences and attitudes strongly influence patients' decisions (22, 23). This study demonstrated that a physician's specialty, self-assessment regarding AS and experience in explaining AS affect their preference for AS. Endocrinologists were more likely to opt for AS compared with surgeons, a finding that aligns with results from a US survey (17). However, other studies have found no differences based on specialty (14). In this study, high self-efficacy was notably influential in the consideration of AS, with an OR of 5.587 compared with cases with low self-efficacy. The lack of self-assessment or knowledge about AS among physicians may act as a barrier to AS (12), highlighting the critical

need for education and information about AS among physicians. Hughes and coworkers reported that physicians affiliated with academic medical centers were more inclined to recommend AS (14). This tendency could be attributed to the greater exposure to AS concepts and more educational opportunities in these centers, underscoring the importance of educating physicians about AS. In this study, while the number of years of experience did not affect the consideration of AS, experience in explaining AS had a significant impact, with an OR of 6.233, indicating a strong influence. In our previous multicenter prospective cohort study of AS on PTMC (MAeSTro study), we assessed the attitudes of 19 physicians toward AS before and after the study (22). In contrast to their initial attitudes, by the end of the study, all physicians considered AS to be the major option for low-risk PTMC (73.7% before the study and 100% after the study), with a decrease in preference for immediate surgery (52.6% before the study and 42.1% after the study). This suggests that experience with AS is more influential than the overall length of general clinical experience. Similar to how experienced surgeons often perform better, physicians with more experience in AS are likely to be more adept at selecting and effectively implementing AS.

Many physicians currently believe that overdiagnosis and overtreatment are prevalent in the management of low-risk thyroid cancer (24, 25). In this survey, physicians acknowledged the potential benefits of AS in avoiding surgery and its complications. However, many are still hesitant to implement AS in practice, leading to its underutilization (11). In a 2018–2019 US survey, 76% of physicians recognized AS as an appropriate alternative approach, yet only 44% reported actually recommending it to their patients (14). The survey highlighted several concerns that deter physicians from opting for AS, including fears of patient complaints or lawsuits, patient anxiety and fear and the possibility of cancer progression or the possibility of more extensive surgery if the cancer worsens. The most frequently cited concern was the risk of patient complaints or lawsuits due to disease progression. Previous US surveys have similarly identified the fear of lawsuits or litigation as a significant barrier to AS (12, 14). AS involves careful monitoring or watchful waiting while avoiding surgery. Misunderstandings about this approach can lead to lawsuits if the cancer progresses. Therefore, it is crucial to provide patients with a thorough explanation and engage in shared decision making before opting for AS. Obtaining informed consent could be one effective strategy to mitigate these risks (11). Next, respondents expressed concerns about patient anxiety and the fear of cancer. Previous studies have also indicated that the fear of cancer significantly influences patient decisions and poses a substantial barrier to undergoing AS (11, 14, 17). Another concern raised was the risk of losing patients to follow-up, echoing issues reported in earlier studies (12, 14).

The most challenging aspects of patient selection included assessing RLN involvement, determining LN metastasis and accounting for patient preferences. Accurately assessing RLN and tracheal invasion, along with detecting LN metastasis, is a task that requires skilled radiologists or examiners and high-quality neck ultrasound (8, 10). Less than 30% of respondents reported significant difficulty in screening patients for AS, which may be attributed to the high number of thyroid specialists involved in the study. In this study, 65% of the participants were members of the KTA and had over 10 years of clinical experience. Physicians with at least 10 years of experience and those who rated their self-assessment skills highly faced significantly fewer challenges in screening suitable patients for AS (Supplementary Table S3). Physician recommendations are often influenced by patient preferences; physicians are more likely to recommend AS if a patient expresses a preference for it (17). However, in actual clinical practice, patients may not be aware of or may not articulate their preferences clearly. This survey also indicates that physicians find it challenging to gauge patient preferences accurately. Future research on the characteristics or personalities of patients who prefer AS may be useful to physicians.

The lack of evidence or ambiguity in guidelines can be barriers to AS (12). In particular, physicians without experience in explaining AS expressed a greater need for guidelines (Supplementary Table S4). Therefore, it is necessary to develop detailed KTA guidelines on AS to guide physicians with limited experience in AS. However, the survey results generally suggest a stronger demand for patient informational or educational materials, psychological support for patients and cost-effectiveness data, rather than for patient selection criteria, protocols or guidelines. This shift may be attributed to the recent publication of numerous research findings and guidelines (7), which may have partially addressed these concerns. The field of thyroid cancer in Korea appears to be transitioning from the early stage of adopting AS to the midterm stage. Providing patients informational or educational materials about AS, such as brochures or videos, can significantly aid physicians in implementing AS. Therefore, more research in this area and the development of decision aids should be actively encouraged. When decision aids were utilized in patients with PTMC, there was a notable increase in the acceptance of AS (22, 26).

This study has some limitations including a cross-sectional design and a small sample size. First, the sample size was small. Although many members are registered online, they do not actively engage in KTA activities. Given that 376 physicians attend the biannual KTA conference, the response rate should not be considered low. However, the results might be influenced by a selection bias stemming from non-respondents. Second, because the study participants were KTA members who are mainly specialists in

thyroid cancer treatment, their perceptions may differ somewhat from those of primary care physicians. Next, there may be a discrepancy between physicians' perceptions and their actual behavior. Through this survey, we investigated physicians' perceptions and attitudes toward AS. However, their perceptions may not necessarily match their actions and medical practices. Although many physicians believe that AS is a good alternative to surgery for PTMC, the actual implementation of AS in their own patients is low (14). Therefore, these factors should be taken into account when interpreting the results of this survey. Finally, the original response options for the questions were four or six categories, but we grouped them into three categories for analysis. A three-point scale may have less discriminatory power than a four- or six-point scale. In addition, this reclassification may introduce some degree of misclassification and measurement error, which could lead to information bias. Therefore, caution is needed when interpreting the results of this study.

For low-risk thyroid cancer, both AS and surgery should be considered as viable treatment options. To do this, physicians should provide patients with adequate information and explanation about AS. However, physicians are often reluctant to recommend AS because of several concerns highlighted in this study. Based on the findings of this study, it is crucial to develop strategies that address physicians' concerns and unmet needs, thereby fostering an environment where physicians can confidently recommend AS to patients.

Supplementary materials

This is linked to the online version of the paper at <https://doi.org/10.1530/ETJ-24-0281>.

Declaration of interest

The authors declare that there is no conflict of interest that could be perceived as prejudicing the impartiality of this work.

Funding

This research was supported by a grant of the Korea Health Technology R&D Project through the Patient-Doctor Shared Decision Making Research Center (PDSDM), funded by the Ministry of Health & Welfare, Republic of Korea (Grant Number RS-2023-KH142322). This study was supported by the Information and Communications Technology and Future Planning of the Basic Science Research Program via the National Research Foundation of Korea (NRF) funded by the BK21FOUR Program of the NRF funded by the Ministry of Education (5120200513755).

Author contribution statement

MJK, JHM, EKL and YJP conceptualized the study; methodology was devised by MJK, JHM, EKL, YSS, KYJ, JYL, JK, WL, KK, SKP and YJP; formal analysis was performed by MJK; original draft was written by MJK; review and editing were carried out by JHM, EKL, YSS, KYJ, YJL, JK, WL, KK, SKP and YJP; and funding was acquired by YJP.

References

- 1 Pizzato M, Li M, Vignat J, *et al.* The epidemiological landscape of thyroid cancer worldwide: GLOBOCAN estimates for incidence and mortality rates in 2020. *Lancet Diabetes Endocrinol* 2022 **10** 264–272. ([http://doi.org/10.1016/S2213-8587\(22\)00035-3](http://doi.org/10.1016/S2213-8587(22)00035-3))
- 2 Lim H, Devesa SS, Sosa JA, *et al.* Trends in thyroid cancer incidence and mortality in the United States, 1974–2013. *JAMA* 2017 **317** 1338–1348. (<http://doi.org/10.1001/jama.2017.2719>)
- 3 Ahn HS, Kim HJ & Welch HG. Korea's thyroid-cancer “epidemic” – screening and overdiagnosis. *N Engl J Med* 2014 **371** 1765–1767. (<http://doi.org/10.1056/NEJMp1409841>)
- 4 Miyauchi A, Ito Y, Fujishima M, *et al.* Long-term outcomes of active surveillance and immediate surgery for adult patients with low-risk papillary thyroid microcarcinoma: 30-year experience. *Thyroid* 2023 **33** 817–825. (<http://doi.org/10.1089/thy.2023.0076>)
- 5 Yoon JH, Choi W, Park JY, *et al.* Active surveillance for low-risk papillary thyroid carcinoma as an acceptable management option with additional benefits: a comprehensive systematic review. *Endocrinol Metab* 2024 **39** 152–163. (<http://doi.org/10.3803/EnM.2023.1794>)
- 6 Haugen BR, Alexander EK, Bible KC, *et al.* 2015 American thyroid association management guidelines for adult patients with thyroid nodules and differentiated thyroid cancer: the American thyroid association guidelines task force on thyroid nodules and differentiated thyroid cancer. *Thyroid* 2016 **26** 1–133. (<http://doi.org/10.1089/thy.2015.0020>)
- 7 Kim MJ, Moon JH, Lee EK, *et al.* Active surveillance for low-risk thyroid cancers: a review of current practice guidelines. *Endocrinol Metab* 2024 **39** 47–60. (<http://doi.org/10.3803/EnM.2024.1937>)
- 8 Sugitani I, Ito Y, Takeuchi D, *et al.* Indications and strategy for active surveillance of adult low-risk papillary thyroid microcarcinoma: consensus statements from the Japan association of endocrine surgery task force on management for papillary thyroid microcarcinoma. *Thyroid* 2021 **31** 183–192. (<http://doi.org/10.1089/thy.2020.0330>)
- 9 Koot A, Soares P, Robenshtok E, *et al.* Position paper from the Endocrine Task Force of the European Organisation for Research and Treatment of Cancer (EORTC) on the management and shared decision making in patients with low-risk micro papillary thyroid carcinoma. *Eur J Cancer* 2023 **179** 98–112. (<http://doi.org/10.1016/j.ejca.2022.11.005>)
- 10 Brito JP, Ito Y, Miyauchi A, *et al.* A clinical framework to facilitate risk stratification when considering an active surveillance alternative to immediate biopsy and surgery in papillary microcarcinoma. *Thyroid* 2016 **26** 144–149. (<http://doi.org/10.1089/thy.2015.0178>)
- 11 Roman BR, Brito JP, Saucke MC, *et al.* National survey of endocrinologists and surgeons regarding active surveillance for low-risk papillary thyroid cancer. *Endocr Pract* 2021 **27** 1–7. (<http://doi.org/10.1016/j.eprac.2020.11.003>)
- 12 Jensen CB, Saucke MC & Pitt SC. Active surveillance for thyroid cancer: a qualitative study of barriers and facilitators to implementation. *BMC Cancer* 2021 **21** 471. (<http://doi.org/10.1186/s12885-021-08230-8>)
- 13 Pitt SC, Yang N, Saucke MC, *et al.* Adoption of active surveillance for very low-risk differentiated thyroid cancer in the United States: a national survey. *J Clin Endocrinol Metab* 2021 **106** e1728–e1737. (<http://doi.org/10.1210/clinem/dgaa942>)
- 14 Hughes DT, Reyes-Gastelum D, Ward KC, *et al.* Barriers to the use of active surveillance for thyroid cancer results of a physician survey. *Ann Surg* 2022 **276** e40–e47. (<http://doi.org/10.1097/SLA.0000000000004417>)
- 15 Park YJ, Lee EK, Song YS, *et al.* 2023 Korean thyroid association management guidelines for patients with thyroid nodules. *Int J Thyroidol* 2023 **16** 1–31. (<http://doi.org/10.11106/ijt.2023.16.1.1>)
- 16 Cho YY, Lee CR, Kang H-C, *et al.* Korean thyroid association guidelines on the management of differentiated thyroid cancers; Part I. Initial management of differentiated thyroid cancers – chapter 2. Surgical management of thyroid cancer 2024. *Int J Thyroidol* 2024 **17** 30–52. (<http://doi.org/10.11106/ijt.2024.17.1.30>)
- 17 McDow AD, Roman BR, Saucke MC, *et al.* Factors associated with physicians' recommendations for managing low-risk papillary thyroid cancer. *Am J Surg* 2021 **222** 111–118. (<http://doi.org/10.1016/j.amjsurg.2020.11.021>)
- 18 Ito Y, Miyauchi A, Kihara M, *et al.* Patient age is significantly related to the progression of papillary microcarcinoma of the thyroid under observation. *Thyroid* 2014 **24** 27–34. (<http://doi.org/10.1089/thy.2013.0367>)
- 19 Miyauchi A, Kudo T, Ito Y, *et al.* Estimation of the lifetime probability of disease progression of papillary microcarcinoma of the thyroid during active surveillance. *Surgery* 2018 **163** 48–52. (<http://doi.org/10.1016/j.surg.2017.03.028>)
- 20 Lee EK, Moon JH, Hwangbo Y, *et al.* Progression of low-risk papillary thyroid microcarcinoma during active surveillance: interim analysis of a multicenter prospective cohort study of active surveillance on papillary thyroid microcarcinoma in Korea. *Thyroid* 2022 **32** 1328–1336. (<http://doi.org/10.1089/thy.2021.0614>)
- 21 Ito Y, Miyauchi A, Fujishima M, *et al.* Thyroid-stimulating hormone, age, and tumor size are risk factors for progression during active surveillance of low-risk papillary thyroid microcarcinoma in adults. *World J Surg* 2023 **47** 392–401. (<http://doi.org/10.1007/s00268-022-06770-z>)
- 22 Hwangbo Y, Choi JY, Lee EK, *et al.* A cross-sectional survey of patient treatment choice in a multicenter prospective cohort study on active surveillance of papillary thyroid microcarcinoma (MAeSTro). *Thyroid* 2022 **32** 772–780. (<http://doi.org/10.1089/thy.2021.0619>)
- 23 Sawka AM, Ghai S, Rotstein L, *et al.* A quantitative analysis examining patients' choice of active surveillance or surgery for managing low-risk papillary thyroid cancer. *Thyroid* 2022 **32** 255–262. (<http://doi.org/10.1089/thy.2021.0485>)
- 24 Jensen CB, Saucke MC, Francis DO, *et al.* From overdiagnosis to overtreatment of low-risk thyroid cancer: a thematic analysis of attitudes and beliefs of endocrinologists, surgeons, and patients. *Thyroid* 2020 **30** 696–703. (<http://doi.org/10.1089/thy.2019.0587>)
- 25 Dedhia PH, Saucke MC, Long KL, *et al.* Physician perspectives of overdiagnosis and overtreatment of low-risk papillary thyroid cancer in the US. *JAMA Netw Open* 2022 **5** e228722. (<http://doi.org/10.1001/jamanetworkopen.2022.8722>)
- 26 Brito JP, Moon JH, Zeuren R, *et al.* Thyroid cancer treatment choice: a pilot study of a tool to facilitate conversations with patients with papillary microcarcinomas considering treatment options. *Thyroid* 2018 **28** 1325–1331. (<http://doi.org/10.1089/thy.2018.0105>)