Cerdika: Jurnal Ilmiah Indonesia, 6 (3), 2026
p-ISSN: 2774-6291 e-ISSN: 2774-6534
Available online at http://cerdika.publikasiindonesia.id/index.php/cerdika/index

A Rare Case Report of an Autonomous Thyroid Nodule (ATN) in a Young Woman from Bali: Restoration of Thyroid Uptake and Improvement in Thyroid Function After Radioactive Iodine (RAI) Therapy

W. Riski Widya Mulyani*, Putu Ayu Sri Saraswati, Priska Gusti Wulandari, Ni Wayan Meindra Wirtayani, Lisa Herawati Diah
Rumah Sakit Umum Daerah Bali Mandara, Indonesia
Email: wriskiwidyam@gmail.com*

Keywords:
subclinical hyperthyroidism, NaI-131, autonomous thyroid nodule, *radioactive iodine*, scintigraphy.

Abstract

Introduction: Autonomic thyroid nodules (NTOs) are *hot nodules* that produce thyroid hormones independently of TSH, suppress the surrounding parenchyma, and can give rise to subclinical or manifest hyperthyroidism. Radioactive iodine (RAI) is the definitive non-surgical therapy of choice due to its effectiveness and safety. A 29-year-old woman with a 3-year-old progressive right neck lump, asymptomatic, taking methimazole 2.5 mg/day routinely. Initial examination (May 2023) showed right ATN with subclinical hyperthyroidism (TSH <0.002 uIU/mL, fT4 1.90 ng/dL, benign isoechoic solid nodule ultrasound results, and right solitary *hot nodule* on SKG (thyroid scintigraphy) with left lobe suppression). RAI (NaI-131 15 mCi) was administered in November 2024 and 6 months thereafter there was a faint recovery of uptake in the left lobe. TSH/FT4 serial conducted: February 2025 (3 months post-RAI) 0.18/0.66; May 2025 (6 months post-RAI) 0.25/0.77; July 2025 (9 months post-RAI) 0.37/0.75. The nodules shrink without additional therapy. SKG (thyroid scintigraphy), alongside laboratory and ultrasound findings, is adequate for the diagnosis of ATN. The selection of RAI over other modalities was consistent with the size of these patients' nodules and comparative evidence of faster improvement in thyroid function and higher success rates. Post-RAI response as expected (uptake recovery in suppressed lobes accompanied by gradual improvement of TSH/fT4). The risk of NTO malignancy is low, so FNAB is not routinely performed, but post-RAI sonographic monitoring remains essential. SKG allows reliable diagnosis of NTO in young women. RAI provides biochemical improvement as well as expected recovery of extranodular uptake, with the need for structured monitoring to detect hypothyroidism and changes in nodule volume.

INTRODUCTION

Autonomous thyroid nodules (ATNs) are solitary nodules that autonomously produce thyroid hormones, causing TSH suppression and appear on scintigraphy as *hot nodules* with suppression of the activity of surrounding or contralateral thyroid tissues. Clinically, ATN can give rise to overt or subclinical hyperthyroidism, which is characterized by suppressed TSH with increased fT4 and T3 or within normal limits (Baumgartner et al. 2017; Eastman et al. 2022; Gencer et al. 2022; Tsai et al. 2021). ATN is the second most common cause of hyperthyroidism in the world. This condition is more common in women and the elderly, with a 4-10 times higher incidence in women and more common in areas with iodine deficiency (Ly et al., 2016; Loscalzo et al., 2022; Pace-Asciak et al., 2020).

Current NTO management options include antithyroid drugs for temporary control, *radioactive iodine* (RAI) as a definitive non-surgical therapy, and surgery on certain indications. *Radiofrequency ablation* (RFA) has been proposed as a minimally invasive

alternative, but recent systematic reviews and comparative meta-analyses show RAI has a superior success rate and safety profile over RFA for ATNs (Giovanella et al., 2024; Yoshihara et al., 2025).

Departing from this context, we present a case of a young woman with ATN that manifested as subclinical hyperthyroidism, confirmed through scintigraphy and managed with RAI until biochemical improvement and *uptake* recovery in previously suppressed lobes (Eastman et al. 2022; Zha et al. 2023). This report highlights the clinical-diagnostic rationale and evidence-based therapy selection in ATN in young patients, including the implications of post-therapy monitoring related to thyroid function, changes in nodule volume, as well as low but clinically relevant vigilance regarding possible malignancy in enlarged *hot nodules* or those with suspicious sonographic features.

The novelty of this case report lies in its comprehensive documentation of the full therapeutic response to RAI in a rare demographic. It meticulously presents the patient's journey from initial presentation, through the diagnostic workup, to the administration of RAI and, crucially, the post-therapy *follow-up* (Chandekar et al. 2026; Fugazzola et al. 2019; Legrand et al. 2024; Pacini et al. 2018; Signore et al. 2023). The report uniquely illustrates both the biochemical normalization of thyroid function (TSH and fT4 over time) and, through serial uptake tests, the physiological "awakening" and recovery of the previously suppressed left thyroid lobe (Au et al. 2016; I. Craig et al. 2025; I. S. Craig et al. 2025; da Fonseca et al. 2021; Hollenberg et al. 2024). This dual documentation provides a holistic view of treatment success that is rarely captured in a single case report.

The primary purpose of this report is to present a rare case of ATN in a young Indonesian woman and to detail its successful management with RAI therapy. The objective is to provide a clear, educational narrative that reinforces current clinical guidelines and highlights the expected therapeutic outcomes, including the functional recovery of extranodular thyroid tissue. The contribution of this work is twofold: it adds a valuable, well-documented case to the global medical literature, and it serves as a practical teaching tool for clinicians, emphasizing the importance of a systematic approach to diagnosis, evidence-based treatment selection, and structured long-term *follow-up* in the management of autonomous thyroid nodules (ATNs).

Case Illustration

A 29-year-old female patient came to the internal medicine polyclinic of the Bali Mandara Regional General Hospital in 2023 with complaints of a lump in the right neck since 3 years earlier. The lump was felt to be gradually enlarging. Clinically, patients do not experience symptoms of thyrotoxicosis such as *dyspnea on exertion*, palpitations, fatigue (weakness), overheating, excessive sweating, restlessness or anxiety (*nervousness*), changes in appetite, and weight changes. The patient had previously routinely taken methimazole 2.5 mg/day since 2021 (2 years earlier) without a history of discontinuation. There was no family history or other significant disease history in the patient. A general physical examination also found no exophthalmos, *lid retraction*, *lid lag*, hyperkinesis, hot hands, sweaty hands, increased heart rate and atrial fibrillation. However, a localized examination of the neck

showed a lump measuring 2x3 cm, hard, moving when the patient swallowed, not accompanied by tenderness, and no *bruit* was detected. The lower boundary of the lump is palpable. The blood vessels of the neck appear normal. Thyroid function is impaired by a decrease in low thyrotropin (TSH) (<0.002 uIU/mL) and an increase in fT4 (1.90 ng/dL).

Ultrasound of the thyroid showed an impression of *a solid isoechoic* mass of a firm boundary with minimal cystic components and multiple calcifications in it with a size of 2.66 x 2.40 x 3.65 cm in the right lobe of the benign suggestive thyroid. In addition, it was also found *to be non-suspicious enlarged right and left cervical lymph nodes* .

The patient underwent thyroid scintigraphy (SKG, *Sidik Kelenjar Gondok*) and *a thyroid uptake test* with a dose of 99m Tc *pertechnetate* dose of 2 mCi in July 2024. Prior to the test, anti-thyroid drugs were withheld (for 5 days) and seafood consumption was avoided (for 2 weeks). Thyroid function re-examination confirmed low TSH (<0.002 uIU/mL) and normal fT4 (1.45 ng/dL). The results of the patient's SKG were obtained with a picture of radioactivity capture in all right thyroid nodules with the left thyroid suppressed (Figure 1). Such a picture corresponds to the autonomous thyroid nodule (ATN) of the right thyroid lobe, with the patient in a subclinical hyperthyroid condition.

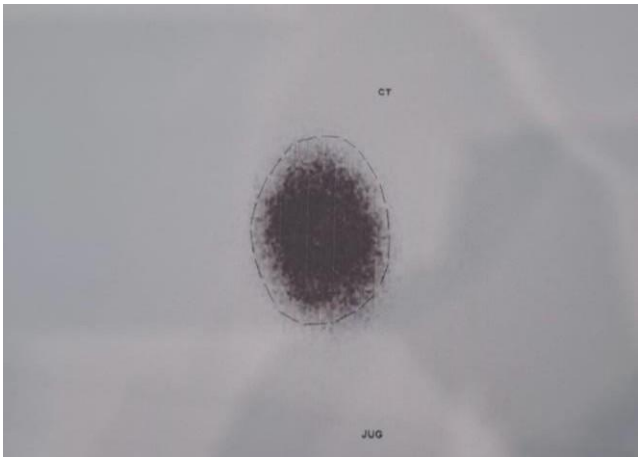

Figure 1. Results of thyroid scintigraphy (SKG) with 99m Tc *pertechnetate* dose 5 mCi

Meanwhile, the results of *the thyroid uptake test* showed *a thyroid uptake* of 3.2% in the right thyroid lobe and *a thyroid uptake* of 0.1% in the left thyroid lobe with a normal reference value for *thyroid uptake* used of 0.5-5% (Figure 2a). Then, the patient was given NaI-131 therapy with a dose of 15 mCi on November 15, 2024, and clinical monitoring, thyroid function tests and *thyroid uptake tests were carried out* on the next control schedule. The patient still did not experience any meaningful symptoms, but the size of the lump on the patient's right neck seemed to shrink. Serial thyroid function checks were carried out in February and May 2025 (figure 1), and *thyroid uptake tests* in May 2025 (6 months after RAI). The results showed a 1% *thyroid uptake* in the right thyroid lobe and a faint capture of radioactivity in the left thyroid lobe (*thyroid uptake* 0.2%) which was previously suppressed (figure 2b).

(a)

(b)

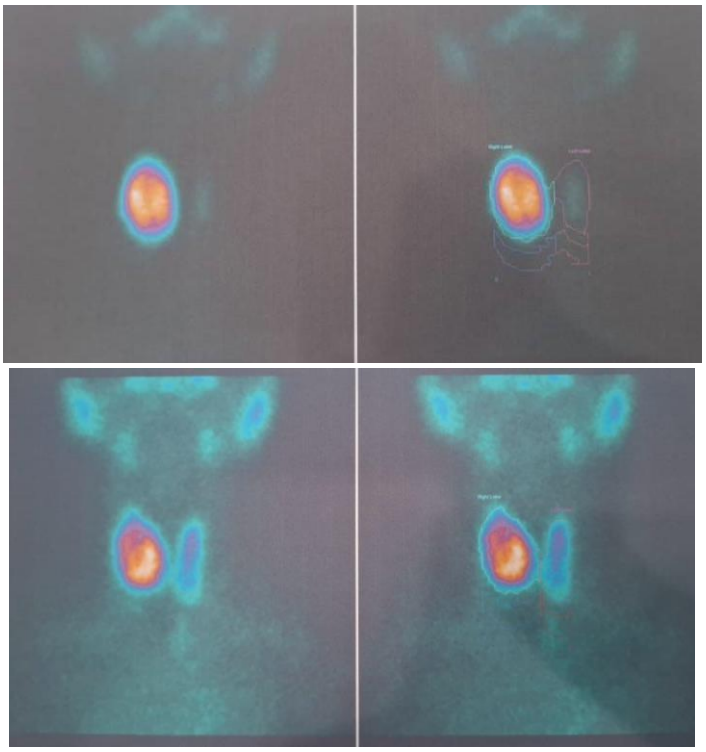

Figure 2. (a) Results *of thyroid uptake test* before RAI; (b) Results *of thyroid uptake test* 6 months post-RAI (NaI-131 dose 15 mCi)

Thyroid function recorded at the next monitoring in July 2025 (9 months post-RAI) showed TSH 0.37 uIU/mL (within normal limits) and FT4 0.75 ng/dL. So it can be concluded that the therapeutic results are NTO improvements with clinical improvement of thyroid function test results. The size of the nodules after therapy is less likely to change. Until now, patients are still advised to have regular checkups to monitor thyroid function and the size of their nodules. No additional treatment is given.

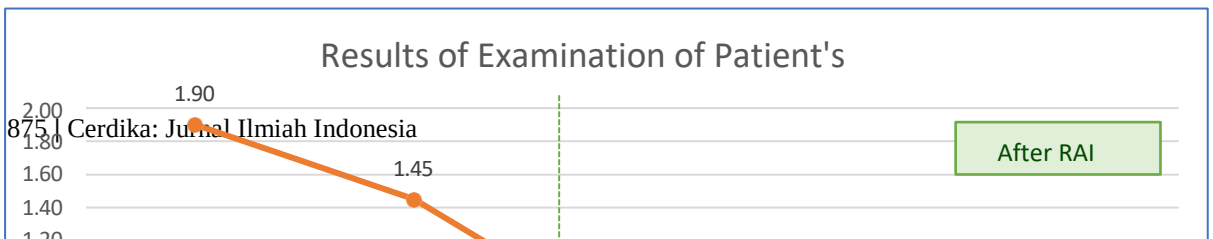

Figure 3. Results of Examination of Patient's Serial Thyroid Function

This case report describes a young woman with an autonomous thyroid nodule (ATN) that causes subclinical hyperthyroidism. NTOs are solitary thyroid nodules that produce thyroid hormones autonomously (TSH-independent), often cause TSH suppression (clinical or subclinical hyperthyroidism), and on scintigraphy appear as a "*hot*" area with suppression of the surrounding or contralateral thyroid parenchyma. Meanwhile subclinical hyperthyroidism is characterized by TSH being suppressed with fT4/T3 within normal limits (Loscalzo et al., 2022). The patient's SKG results showed a right thyroid nodule with increased radioactivity capture and suppression of the left lobe of the thyroid, thus consistent with NTO. While the biochemical profile in the early stages of the patient's arrival indicates subclinical hyperthyroidism.

Autonomous thyroid nodules (ATNs) are the second most common cause of hyperthyroidism after Graves' disease. About 5–10% of benign thyroid nodules can develop into ATNs, although exact epidemiological data are still not well documented at this time. The incidence of NTO is more frequent in the elderly population and women (4–10 times more frequent than men) (Pace-Asciak et al., 2020). Cases in young women such as those found in these patients are still relatively rare.

Autonomic nodules usually develop from small nodules that progressively suppress TSH. As the nodule grows, its contribution to thyroid hormone secretion increases and can lead to thyrotoxicosis (Khare et al., 2013). However, clinically, thyrotoxicosis due to NTO is often mild and generally only manifests itself when the nodule diameter is >3 cm (Loscalzo et al., 2022). The patients we reported showed asymptomatic characteristics, regardless of size (indicated by ultrasound results) had the largest dimensions of more than 3 cm and the patient stated that there was a possibility of increasing the size before.

Mutations in TSH receptor activation (TSHR) or Gs protein α subunits (GNAS) in follicular cells trigger adenylate cyclase activation, increased cAMP signaling, and autonomous, unstimulated proliferation and synthesis of hormones. In some cases, there is a

term "*second hit*" in the form of an EZH1 mutation (p.Gln571Arg) that increases the epigenetic labeling of H3K27me3 and promotes clonal growth, making nodule independence stronger. As the nodule enlarges and the production of autonomic hormones increasingly suppresses pituitary TSH, extranodular tissue function decreases and a typical scintigraphic pattern appears in the form of solitary *hot nodules* with a suppressed *background uptake* (Calebiro et al., 2016; Loscalzo et al., 2022; and Khare et al., 2013). This is in accordance with the results of the SKG examination found in this case

Symptoms and signs of NTO generally vary from subclinical to overt hyperthyroidism, including those listed on the *Wayne index* (*dyspnea on exertion*, palpitations, weakness, overheating, excessive sweating, restlessness or *nervousness*, changes in appetite, weight changes, palpated thyroid, *bruit* in the thyroid, exophthalmos, *lid retraction*, *lid lag*, hyperkinesis, hot *Hands*, sweaty hands, increased heart rate, and atrial fibrillation). Untreated hyperthyroidism will not only increase the risk of atrial fibrillation, but can also lead to osteoporosis and fractures, as well as cardiovascular and neurological complications (Ross et al., 2016; Pace-Asciak et al., 2020; Pemayun et al., 2022). Other than the palpated thyroid nodules, no other symptoms and signs were found in this patient. It is very possible that this is influenced by subclinical hyperthyroid characteristics in the patient. This point highlights the importance of conducting biochemical screening when nodules are found, regardless of the absence of symptoms present.

Thyroid scintigraphy (SKG) in ATN will show an increase in focal *uptake* in one nodule with a decrease or no *uptake* in the extranodular thyroid parenchyma. While ultrasound examination is used to assess size, composition, sonographic risk patterns and volume monitoring (Loscalzo et al., 2022; Yoshihara et al., 2025). In this case, only laboratory examinations of thyroid function, ultrasound, and SKG were conducted for diagnosis, consistent with the characteristics of ATN. Because ATNs have a small risk of malignancy, more invasive measures such as FNAB are generally not necessary, especially when *hot nodules* have been found without other suspicious features (Loscalzo et al., 2022). However, evidence of reports of a malignant case developing in *hot nodule*s has been documented in 2008 (Uludag et al., 2008). Therefore, monitoring of warning signs such as enlarged nodules (especially post-RAI) or suspicious ultrasound findings (such as those performed in this patient) needs to be performed.

Graves' disease and toxic multinodular goiter were differentiated using antibody status and scintigraphic patterns. In SKG, ATN shows solitary *hot nodules* with extranodular suppression, while Graves' disease shows diffuse *uptake* and toxic multinodular goiter shows multiple hot areas (areas with increased *uptake*) and is separated by cold areas with heterogeneous patterns (appearing *patchy*) (Gundgurthi et al., 2012; Avs et al., 2017; Loscalzo et al., 2022; Yoshihara et al., 2025). Therefore, the suspicion of Graves' disease and toxic multinodular goiter was ruled out in this case, although no antibody status examination was carried out in the patient.

The goal of treatment is to normalize thyroid function to reduce the burden of symptoms and lower risks such as atrial fibrillation and osteoporosis, even in subclinical

diseases. Hyperthyroidism due to thyroid nodular disease is permanent without spontaneous remission. Antithyroid medications can decrease the secretion of thyroid hormones but are not appropriate for long-term therapy. Similarly, surgery can be performed for large multinodular goiters, which cause compressive symptoms or cosmetic concerns (Khare et al., 2013). Guidelines recommend nodule volumes of less than 15 mL as a reference threshold for selecting *radioactive iodine* (RAI) therapy in NTO treatment (Yoshihara et al., 2025). Another option that has recently been frequently proposed is *radiofrequency ablation* (RFA) (Giovanella et al., 2024).

Through the use of the isotope I-131 taken as a capsule or solution, RAI destroys overactive thyroid tissue or the rest of certain thyroid tissue in a directed manner, as the thyroid gland selectively absorbs iodine through the *sodium–iodide symporter* so that radiation exposure will be concentrated in the thyroid with relatively minimal damage to normal tissue. The usual dose is given around 370–1110 MBq (10–29.9 mCi) (Pace-Asciak et al., 2020; Yoshihara et al., 2025). A large cohort in Japan examined the long-term effects of single-dose fixed-dose RAI (500 MBq) on ATN patients. Nodule volume reportedly decreased to 47% in the first year while the median time to achieve euthyroidism after RAI was 90 days (Yoshihara et al., 2025). *Radiofrequency ablation* (RFA) is a minimally invasive procedure that is guided by ultrasound. RFA is successfully applied to reduce non-NTO volumes and reduce mechanical complaints due to nodular compression. Recently RFA was proposed as a treatment option for hyperthyroidism caused by ATN, but a 2024 meta-analysis shows that RAI is significantly better than RFA in treating ATN. Specifically, TSH increased slowly and normally in only 59% of patients after RFA, compared to significantly faster response and higher levels of TSH normalization in 94% of patients treated with RAI. These findings demonstrate RAI's superiority over RFA in terms of success rate and safety profile, making RAI the first choice for ATN treatment (Giovanella et al., 2024). Based on this, RAI was chosen in the treatment of this patient.

Preparation and interpretation before performing SKG and *thyroid uptake tests* need to take into account medication and iodine exposure to avoid *false negative* or *false positive results*, and are used to distinguish from other hyperthyroid etiologies (Pemayun et al., 2022). Therefore, anti-thyroid drugs were withheld (for 5 days) and seafood consumption was avoided (for 2 weeks) prior to these tests in this patient.

NaI-131 therapy of 15 mCi dose on NTO in this case was adjusted to first-line recommendations for NTO, *follow-up* findings showed biochemical improvement and initiation of *uptake* recovery in previously suppressed lobes, in line with the expected post-therapy response, with nodule size beginning to shrink. After RAI, thyroid function is usually checked monthly for 4 months, then at 6 months, 1 year, and annually, ultrasound monitors changes in nodule volume and detects growth (Yoshihara et al., 2025). Post-RAI hypothyroidism in NTO may develop within a few months to a year after therapy. This condition is not a complication, but rather a therapeutic consequence that can be treated with levothyroxine as per clinical needs (Yoshihara et al., 2025). Regardless of adequate monitoring of thyroid function, patients in this case should also be advised to have a repeat

ultrasound to monitor for definite changes in the size of the nodules.

CONCLUSION

This case report describes a 29-year-old Indonesian woman presenting with a three-year history of an asymptomatic right neck lump, who was diagnosed with a right autonomous thyroid nodule (ATN) causing subclinical hyperthyroidism (TSH <0.002 µIU/mL, fT4 1.90 ng/dL), confirmed by thyroid scintigraphy (SKG) showing a solitary hot nodule with complete suppression of the left lobe and ultrasound revealing a 2.66 × 2.40 × 3.65 cm isoechoic solid nodule in the right thyroid lobe. Radioactive iodine therapy (NaI-131, 15 mCi) was administered in November 2024 following standard preparation (methimazole withdrawal for five days, seafood avoidance for two weeks); serial monitoring over nine months demonstrated progressive biochemical improvement (TSH rising from <0.002 to 0.37 µIU/mL and fT4 normalizing to 0.75 ng/dL) alongside the gradual physiological recovery of uptake in the previously suppressed left lobe, while nodule volume began to diminish without additional therapy. The authors conclude that SKG is reliable for ATN diagnosis in young women, that RAI is superior to radiofrequency ablation (RFA) in terms of TSH normalization rates (94% vs. 59%) and safety, and that structured long-term follow-up remains essential to detect post-therapy hypothyroidism and monitor nodule volume, with fine-needle aspiration biopsy (FNAB) reserved for nodules developing suspicious sonographic features. For future research, a prospective multicenter study in Indonesian and other iodine-sufficient and iodine-deficient populations comparing fixed-dose versus calculated-dose RAI regimens in young women with ATN would help clarify optimal dosing strategies, while long-term follow-up data beyond one year capturing rates of hypothyroidism, nodule recurrence, and quality of life would strengthen evidence-based guidelines for this relatively rare demographic.

REFERENCES

Au, C. M. C., Britt, K., & Docanto, M. (2016). Des-acyl ghrelin inhibits oestrogen-stimulated breast tumour growth in vitro and in vivo. *Clinical …*

Avs, A. K., Mohan, A., Kumar, P. G., & Puri, P. (2017). Scintigraphic profile of thyrotoxicosis patients and correlation with biochemical and sonological findings. *Journal of Clinical and Diagnostic Research, 11*(5), OC01–OC03.

Baumgartner, C., et al. (2017). Thyroid function within the normal range, subclinical hypothyroidism, and the risk of atrial fibrillation. *Circulation.*

Calebiro, D., Grassi, E. S., Eszlinger, M., Ronchi, C. L., Godbole, A., Bathon, K., Guizzardi, F., de Filippis, T., Krohn, K., Jaeschke, H., Schwarzmayr, T., Bircan, R., Gozu, H. I., Sancak, S., Niedziela, M., Strom, T. M., Fassnacht, M., Persani, L., & Paschke, R. (2016). Recurrent EZH1 mutations are a second hit in autonomous thyroid adenomas. *The Journal of Clinical Investigation, 126*(9), 3383–3388.

Chandekar, K. R., Ravindra, S. G., & Satapathy, S. (2026). Radioiodine therapy in the management of differentiated thyroid cancer. In *Controversies in Cancer of …*

Craig, I., Gilmore, D., & Brown, W. (2025). Neuroendocrine communication within sport. In *Integrative Sport and Exercise …*

Craig, I. S., Gilmore, D., & Brown, W. S. (2025). *Neuroendocrine communication within*

sport and exercise. Routledge.

da Fonseca, M. A., & Kratunova, E. (2021). Management of medically compromised paediatric patients. In *Handbook of Pediatric Dentistry …*

Eastman, C. J., & Blumenthal, N. J. (2022). Gestational subclinical hypothyroidism. In *Thyroid diseases in pregnancy.*

Fugazzola, L., et al. (2019). 2019 European Thyroid Association guidelines for the treatment and follow-up of advanced radioiodine-refractory thyroid cancer. *European Thyroid Journal.*

Gencer, B., Cappola, A. R., & Rodondi, N. (2022). Challenges in the management of atrial fibrillation with subclinical hyperthyroidism. *Frontiers in …*

Giovanella, L., Garo, M. L., Campenní, A., & Ovčariček, P. P. (2024). Radioiodine versus radiofrequency ablation to treat autonomously functioning thyroid nodules: A systematic review. *…*

Hollenberg, A., Wiersinga, W. M., Bartalena, L., & Feldt-Rasmussen, U. (2024). Hyperthyroid disorders. *Research Portal Denmark.*

Legrand, A., et al. (2024). Health-related quality of life and radioiodine therapy in thyroid cancer patients: A before-and-after study. *Quality of Life Research.*

Loscalzo, J., Kasper, D., Longo, D., Fauci, A., Hauser, S., & Jameson, J. (2022). *Harrison's principles of internal medicine* (21st ed.). McGraw-Hill.

Pacini, F., et al. (2018). Italian consensus on diagnosis and treatment of differentiated thyroid cancer: Joint statements of six Italian societies. *Journal of Endocrinological Investigation.*

Pace-Asciak, P., Russell, J. O., Shaear, M., & Tufano, R. P. (2020). Novel approaches for treating autonomously functioning thyroid nodules. *Frontiers in Endocrinology, 11*, 565371.

Pemayun, T. G. D., Seno, K. H. N. H., & Minuljo, T. T. (2022). *Capita thyroid selector* (Edition 1). Indonesian Thyroid Association.

Ross, D. S., Burch, H. B., Cooper, D. S., Greenlee, M. C., Laurberg, P., Maia, A. L., et al. (2016). 2016 American Thyroid Association guidelines for diagnosis and management of hyperthyroidism and other causes of thyrotoxicosis. *Thyroid, 26*(10), 1343–1421.

Signore, A., et al. (2023). Predictive role of serum thyroglobulin after surgery and before radioactive iodine therapy in patients with thyroid carcinoma. *Cancers.*

Tsai, K., & Leung, A. M. (2021). Subclinical hyperthyroidism: A review of the clinical literature. *Endocrine Practice.*

Yoshihara, A., Yoshimura Noh, J., Inoue, K., Koshibu, M., Hirose, R., Ichikawa, M., Suzuki, N., Matsumoto, M., Fukushita, M., Watanabe, N., Sugino, K., & Ito, K. (2025). Long-term outcomes after radioactive iodine treatment for a single autonomous functioning thyroid nodule in Japan. *Endocrine Journal, 72*(5), 487–494.

Zha, L., et al. (2023). Abstracts from the 71st Annual Meeting of the British Thyroid Association. *Thyroid Research.*