

The Significance of Microwave Ablation of Thyroid Nodules in Anesthesia

Anchala Jirakulsawat¹, Supanadee Jianwittayakit², Sirijunya Junyatham², Nisa Noocharoen¹,
Phongthara Vichitvejpaisal²

¹ Division of Operating Nursing, Golden Jubilee Medical Center, Faculty of Medicine Siriraj Hospital, Mahidol University, Nakhon Pathom 73170, Thailand

² Department of Anesthesiology, Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok 10700, Thailand

Abstract

Microwave ablation has emerged as a significant therapeutic option for the treatment of thyroid nodules, offering several advantages over traditional surgical approaches. The use of microwave ablation for thyroid nodules provides a minimally invasive alternative to surgery, minimizing patient discomfort and reducing the risk of complications. Anesthesia provider plays a crucial role in optimizing patient comfort. Anesthesia techniques, such as sedation or monitored anesthesia care, can also be utilized to alleviate anxiety and pain during the treatment. Furthermore, anesthesia administration allows for the precise and controlled delivery of microwave energy to the targeted thyroid nodules, ensuring optimal outcomes. Anesthesia personnel closely monitor vital signs, ensuring patient safety during the procedure and promptly addressing any potential complications. The preservation of thyroid function is another significant advantage of microwave ablation. Anesthesia enables the selective ablation of thyroid nodules while sparing the surrounding

healthy thyroid tissue, minimizing the risk of post-procedural hypothyroidism and the need for hormone replacement therapy.

Keywords: anesthesia, microwave ablation, monitored anesthesia care

Key points

- Microwave ablation is a minimally invasive procedure that uses electromagnetic waves to destroy abnormal tissue, providing a promising treatment option for various conditions, including thyroid nodules.
- Anesthesia plays a crucial role in microwave ablation procedures, ensuring patient comfort, safety, and procedural success. The choice of anesthesia depends on factors such as the complexity of the procedure and the patient's medical history.
- Collaboration between anesthesiologists and interventional radiologists is vital for safe and successful microwave ablation procedures, optimizing patient outcomes and enhancing procedural efficiency.

Introduction

Microwave ablation (MWA) is a minimally invasive procedure that uses electromagnetic waves to generate heat and destroy abnormal tissue, leading to coagulation necrosis and the destruction of abnormal cells.^{1,2} It has various applications, including the treatment of thyroid nodules, liver tumors, lung tumors, and renal tumors.^{3,4} The MWA technique involves a pre-procedure assessment, which includes evaluating the patient's suitability for the procedure and conducting imaging studies to identify the target tissue. During the procedure, anesthesia is administered, a microwave antenna is inserted into the nodule under imaging guidance, and the microwave generator is activated to emit waves and generate heat.^{5,6} Patients often experience a faster recovery compared to surgery,⁷ and organ function is preserved as it selectively targets abnormal tissue while minimizing damage to healthy structures.⁶ In many cases, it can be performed on an outpatient basis, eliminating the need for hospitalization.⁸

Thyroid nodules are abnormal growths within the thyroid gland that can be benign or malignant. Multiple factors contribute to the development of thyroid nodules, including age, gender, radiation exposure, family history, and iodine deficiency or excess. Treatment options vary depending on the diagnosis, with benign nodules potentially requiring observation, hormone suppression therapy, or minimally invasive procedures like MWA. Malignant nodules or those suspicious for malignancy may necessitate surgical removal, radioactive iodine

therapy, or targeted therapy based on the specific type and stage of thyroid cancer.^{9,10}

What is microwave ablation?

MWA is a minimally invasive procedure that uses electromagnetic waves to generate heat and destroy abnormal tissue in thyroid nodules. It offers advantages over surgery, such as faster recovery, reduced scarring, preservation of thyroid function, reduced scarring, shorter recovery time, and lower risks compared to surgery. It is suitable for larger or vascular nodules and does not require injecting substances. Anesthesia is essential for patient comfort and safety during MWA, and its approach is tailored to individual needs. The procedure continues to advance, improving outcomes and quality of life.^{11,12} It selectively targets abnormal tissue while preserving healthy thyroid tissue and maintaining thyroid function.¹³ MWA offers a safe and effective alternative to surgery for selected patients, providing minimal invasiveness and faster recovery while preserving thyroid function.^{14,15}

Potential complications

Addressing potential complications and risks is crucial in MWA procedures. Strategies to mitigate complications include using image-guided techniques, proper skin preparation, and monitoring skin temperature. Bleeding risks are managed through monitoring and hemostatic techniques. Pain and discomfort are alleviated with anesthesia and analgesic medications. Voice changes are minimized through accurate probe placement. Thyroid

function changes are monitored and managed post-procedure. Infection risks are reduced through sterile techniques and antibiotics. Allergic reactions are addressed through pre-procedural assessment and immediate management. Rare but serious complications require thorough patient selection, accurate techniques, and vigilant monitoring. Overall, by implementing these strategies, the healthcare team ensures patient safety and minimizes complications in MWA procedures.¹⁶

Importance of anesthesia

Anesthesia is crucial for ensuring patient comfort, safety, and procedural success. Its primary role is to manage pain, promote patient cooperation, and reduce stress and anxiety. By providing a controlled and monitored state, anesthesia optimizes the procedure, enhances patient immobility, and facilitates accurate treatment delivery. Anesthesia can be tailored to meet each patient's specific needs, making it essential to discuss medical history and concerns with the healthcare provider to ensure an individualized approach. The various anesthesia options available include local anesthesia, conscious sedation, and general anesthesia.¹⁷ Local anesthesia offers minimal systemic effects and real-time feedback, conscious sedation reduces anxiety and improves cooperation, while general anesthesia provides complete pain control for complex procedures. Anesthesia providers also play a role in post-operative pain management and facilitating a smooth recovery. Pre-operative assessment and preparation are crucial for the safety and success of patients

undergoing MWA. It involves reviewing the patient's medical history, conducting a physical examination, and ordering diagnostic tests. Attention is given to medical conditions, allergies, and medications that may impact anesthesia or the procedure. A thorough physical examination focuses on the neck and thyroid area. Diagnostic tests such as thyroid function tests, ultrasound, and biopsy provide additional information. Patients receive pre-operative instructions, including fasting and medication management. Informed consent is obtained after explaining the procedure and associated risks. The process ensures patient readiness, minimizes risks, and allows for individualized care. Patients should follow instructions, communicate changes, and maintain open dialogue with the healthcare team.

During MWA, continuous monitoring and management are crucial for patient safety and well-being. Vital signs such as blood pressure, heart rate, and oxygen saturation are closely monitored. Anesthesia is carefully managed to maintain appropriate sedation or unconsciousness. Pain is effectively managed using local anesthesia, conscious sedation, or general anesthesia.¹⁸ Clear communication with the patient or caregiver is maintained to address concerns and provide reassurance. The proceduralist monitors the progress of the procedure and ensures accurate probe placement. Emergency preparedness is prioritized with necessary equipment and trained staff. Overall, continuous monitoring and management ensure patient safety, optimize the procedure's success, and enable prompt response to any complications that may arise.

Minimizing patient discomfort and pain is a crucial aspect of MWA procedures. Effective communication and education help manage discomfort, while proper positioning and support ensure patient comfort. The healthcare team aims to enhance patient comfort and improve the overall experience of the procedure.¹⁹ Enhancing patient cooperation is crucial for the success of MWA procedures. Ensuring patient immobility and procedural accuracy is crucial for the safe and effective execution of MWA procedures. Proper patient positioning, education, and cooperation help maintain stability and minimize movement.

Anesthetic considerations

The choice of anesthesia in MWA for thyroid nodules is crucial for patient comfort, safety, and procedural success. General anesthesia provides complete sedation and immobility, ensuring patient comfort and optimal surgical conditions. Local anesthesia allows patients to remain awake and aware, reducing systemic effects and enabling communication. Factors such as patient characteristics, nodule properties, and surgeon experience influence the anesthesia choice.²⁰ Regional anesthesia targets specific nerves for pain relief in certain regions of the body. Patient safety and comfort, surgical conditions, recovery considerations, and cost/resource availability are key considerations in anesthesia selection. Selecting the appropriate anesthesia approach comes with challenges that must be overcome for optimal patient outcomes. Patient-related challenges include comorbidities and anxiety, which can be managed through thorough assessment, optimization,

and communication. Effective post-operative pain management and recovery are crucial for patient comfort, early mobilization, and overall healing. Multimodal approaches, including pharmacological interventions, regional anesthesia techniques and non-pharmacological interventions offer comprehensive pain relief.

Multidisciplinary approach

Collaboration between anesthesiologists and interventional radiologists is crucial for safe and successful interventional radiology procedures. By working together, they ensure patient safety, optimize procedural planning, and enhance patient comfort.²¹ This collaboration allows for comprehensive patient assessment, appropriate anesthesia management, and seamless integration of pain control techniques. It improves communication, coordination, and procedural efficiency, minimizing complications and reducing patient anxiety. Interdisciplinary collaboration ensures clear communication among healthcare providers and patient education, enabling informed decision-making and obtaining informed consent. Ensuring patient-centered care and optimal outcomes is a fundamental goal in healthcare. Patient-centered care focuses on meeting individual needs, enhancing satisfaction, and improving communication and collaboration.

Future directions

Emerging advancements in MWA and anesthesia techniques are revolutionizing interventional procedures. MWA is expanding its

applications to various tumors and non-tumor conditions. Ongoing advancements and research are expected to further enhance the role of MWA in the treatment of thyroid nodules, benefiting both patients and healthcare providers. Anesthesia advancements include ultrasound-guided regional anesthesia, enhancing nerve blocks and safety, and total intravenous anesthesia, improving drug delivery and reducing side effects. Technology integration and monitoring advancements further optimize anesthesia management. Ongoing studies focus on areas such as anesthetic drug optimization, pain management and opioid-sparing techniques, anesthesia in special populations, technology and monitoring, and patient safety and outcomes.

Conclusion

MWA has revolutionized the treatment of thyroid nodules, offering a minimally invasive approach with numerous benefits. Anesthesia providers play a crucial role in monitoring vital signs, ensuring patient safety, and promptly addressing any complications that may arise during the procedure. The significance of anesthesia in MWA extends beyond the procedural aspects. It encompasses patient-centered care, ensuring that patients undergo the treatment with minimal discomfort, anxiety, and pain. Anesthesia providers, alongside the multi-disciplinary team, play a pivotal role in optimizing the patient experience, promoting safety, and contributing to the success of the procedure.

References

1. Wu W, Gong X, Zhou Q, Chen X, Chen X. Ultrasound-guided percutaneous microwave ablation for solid benign thyroid nodules: comparison of MWA versus control group. *Int J Endocrinol*. 2017;2017:9724090.
2. Wu W, Gong X, Zhou Q, Chen X, Chen X, Shi B. US-guided percutaneous microwave ablation for the treatment of benign thyroid nodules. *Endocr J*. 2017;64:1079-85.
3. Yang YL, Chen CZ, Zhang XH. Microwave ablation of benign thyroid nodules. *Future Oncol*. 2014;10:1007-14.
4. Yue W, Wang S, Wang B, et al. Ultrasound guided percutaneous microwave ablation of benign thyroid nodules: safety and imaging follow-up in 222 patients. *Eur J Radiol*. 2013;82: 11-6.
5. Honglei G, Shahbaz M, Farhaj Z, et al. Ultrasound guided microwave ablation of thyroid nodular goiter and cystadenoma: a single center, large cohort study. *Medicine (Baltimore)*. 2021;100:e26943.
6. Li S, Yang M, Guo H, Liu M, Xu S, Peng H. Microwave ablation vs traditional thyroidectomy for benign thyroid nodules: a prospective, non-randomized cohort study. *Acad Radiol*. 2022;29:871-9.
7. Wu X, Jiang Z, Liu J, et al. The efficacy and safety of microwave ablation versus conventional open surgery for the treatment of papillary thyroid microcarcinoma: a systematic review and meta-analysis. *Gland Surg*. 2022;11:1003-14.
8. Gala KB, Shetty NS, Patel P, Kulkarni SS. Microwave ablation: how we do it? *Indian J Radiol Imaging*. 2020;30:206-13.
9. Alexande EK, Doherty GM, Barletta JA. Diagnosis of thyroid nodules. *Front Endocrinol (Lausanne)*. 2022;10:540-8.
10. Kant R, Davis A, MD, Verma V. Thyroid nodules: advances in evaluation and management. *Am Fam Physician*. 2020;102:298-304.
11. Luo F, Huang L, Gong X, et al. Microwave ablation

- of benign thyroid nodules: 3-year follow-up outcomes. *Head Neck*. 2021;43:3437-47.
12. Teng DK, Li WH, Du JR, Wang H, Yang DY, Wu XL. Effects of microwave ablation on papillary thyroid microcarcinoma: a five-year follow-up report. *Thyroid*. 2020;30:175-58.
 13. Cui T, Jin C, Jiao D, Teng D, Sui G. Safety and efficacy of microwave ablation for benign thyroid nodules and papillary thyroid microcarcinomas: a systematic review and meta-analysis. *Eur J Radiol*. 2019;118:58-64.
 14. Wang X, Niu X, Mu S, et al. Analysis and evaluation of the efficacy of ultrasound-guided microwave ablation for papillary thyroid microcarcinoma. *Int J Hyperthermia*. 2021;38:1476-85.
 15. Papini E, Crescenzi A, D'Amore A, et al. Italian guidelines for the management of non-functioning benign and locally symptomatic thyroid nodules. *Endocr Metab Immune Disord Drug Targets*. 2023;23:876-85.
 16. Fu QQ, Kang S, Wu CP, et al. A study on the efficacy of microwave ablation for benign thyroid nodules and related influencing factors. *Int J Hyperthermia*. 2021;38:1469-75.
 17. Gao S, Zhu Y, Tong M, et al. Different effects of intravenous and local anesthesia in patients undergoing ultrasound-guided radiofrequency ablation of thyroid nodules: a prospective cohort study. *Int J Hyperthermia*. 2022;39:1036-43.
 18. Li Z, Wang C, Li J, et al. MR-guided microwave ablation of hepatocellular carcinoma (HCC): is general anesthesia more effective than local anesthesia? *BMC Cancer*. 2021;562:2-9.
 19. Du JR, Li WH, Quan CH, Wang H, Teng DK. Long-term outcome of microwave ablation for benign thyroid nodules: over 48-month follow-up study. *Front Endocrinol (Lausanne)*. 2022;13:941137.
 20. Piccioni F, Poli A, Templeton LC, et al. Anesthesia for percutaneous radiofrequency tumor ablation (PRFA): a review of current practice and techniques. *Local Reg Anesth*. 2019;12:127-37.
 21. Fenton ME, Wade SA, Pirili BN, Balogh ZJ, Rowe CW, Bendinelli C. Variability in thyroid cancer multidisciplinary team meeting recommendations is not explained by standard variables: outcomes of a single centre review. *J Clin Med*. 2021;10:4150.