INFORMATION BRIEF (RAPID REVIEW)

USE OF MICROWAVE AND RADIOFREQUENCY ABLATION FOR THE TREATMENT OF THYROID NODULES

Malaysian Health Technology Assessment Section (MaHTAS)
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PURPOSE

This review was conducted upon request by the Medical Practice Division, Ministry of Health Malaysia, to provide information on the effectiveness, safety and cost-effectiveness of microwave ablation (MWA) and radiofrequency ablation (RFA) for the treatment of thyroid nodules, in response to a request regarding these procedures as they are currently not listed in the Thirteenth Schedule of the Private Healthcare Facilities and Services (Private Hospitals and Other Private Healthcare Facilities) (Amendment) Order 2013.

BACKGROUND

Thyroid nodules are common clinical findings characterised as discrete lesions within the thyroid gland, resulting from abnormal focal growth of thyroid cells. The prevalence of thyroid nodule in the Malaysian population is reported at 3.6%.[1] Most thyroid nodules are benign, commonly presenting as hyperplastic (colloid) nodules or follicular adenomas.[1] Ultrasonography detects thyroid nodules at a high rate, with 90%–95% being benign, while malignancy is relatively uncommon, occurring in approximately 5% to 10% of cases.[2,3]

Based on the Malaysian Clinical Practice Guidelines for Management of Thyroid Disorders (2019), management of thyroid nodules should be guided by clinical presentation, cytology results, and risk stratification. Observation is appropriate for small, asymptomatic nodules, while options such as thyroid hormone suppression, radioiodine therapy, ethanol injection, or surgery may be considered based on nodule characteristics, presence of symptoms, cytological findings, and patient-specific risk factors. However, it is important to note that the guidelines only included evidence up to 2017, and modalities such as MWA and RFA were not considered during the guideline development.[1]

While most benign thyroid nodules do not require treatment, intervention is warranted when they cause symptoms, increase in size, or raise suspicion of malignancy. Conventional surgery remains the standard treatment for such cases; however, it carries potential risks, including recurrent laryngeal nerve injury, parathyroid gland damage, hypothyroidism, and scar formation.[4] Thyroidectomy leaves a permanent scar and necessitates lifelong levothyroxine replacement, which discourages many patients from opting for surgery.[5,6] Therefore, there is a growing need for less invasive alternatives that can reduce the treatment burden on patients.

Minimal invasive techniques such as thermal ablation, which includes MWA and RFA, have emerged as promising non-surgical alternatives. Thermal ablation works by directly applying heat to target tissues, causing pathological damage while sparing the surrounding healthy cells.[7] These techniques, performed in a day-hospital setting, offer an effective therapeutic outpatient option for reducing nodule size and relieving local symptoms without the need for general anaesthesia, while posing minimal risk of permanent complications or thyroid function loss when performed in specialized centers.[8-10]

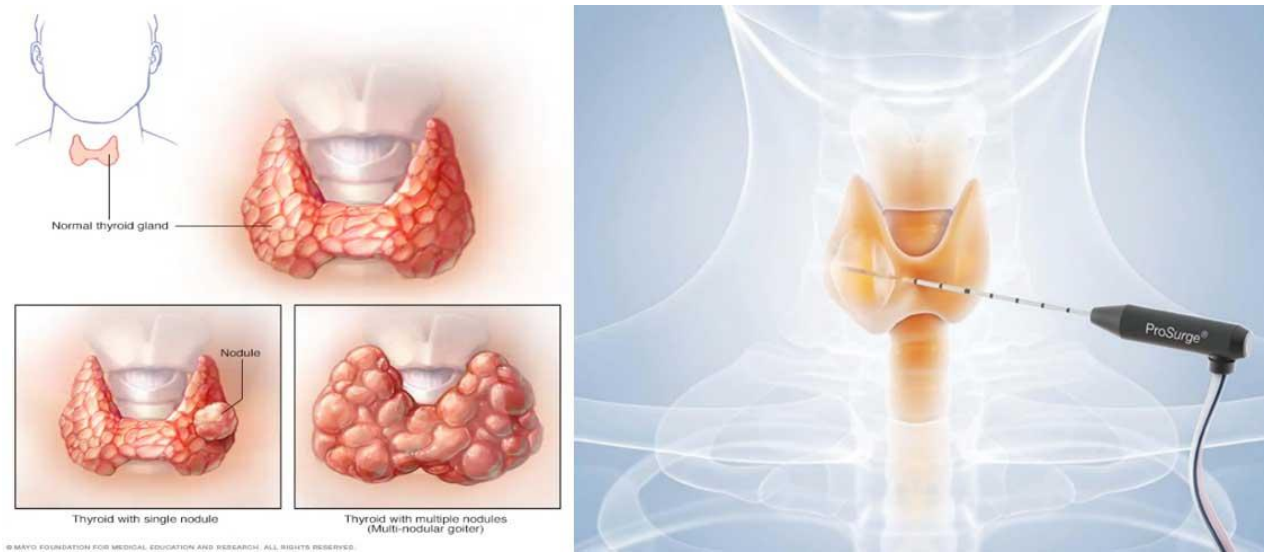

Figure 1. Microwave ablation (MWA) for thyroid nodule.
Source: https://flowcare.co.in/ablation23/

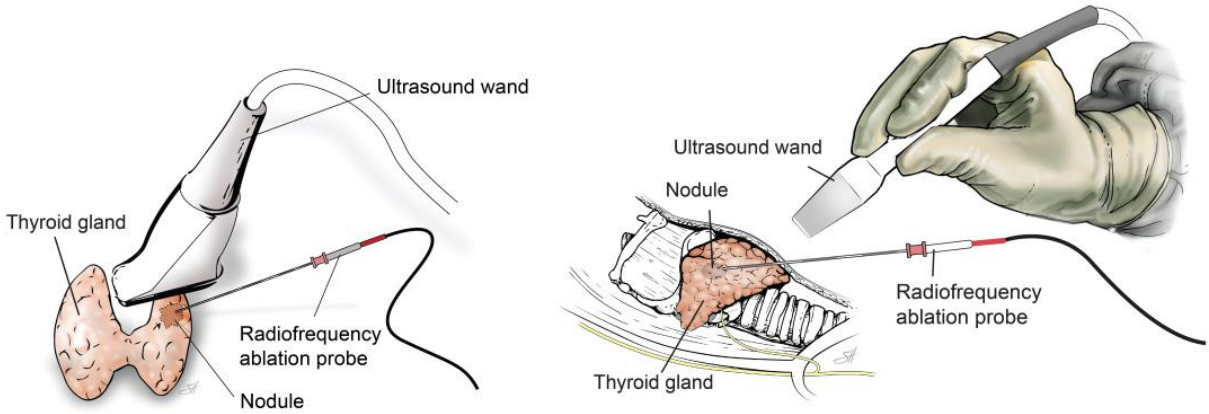

Figure 2. Radiofrequency ablation (RFA) for thyroid nodule.
Source: https://www.bcm.edu/healthcare/specialties/endocrinology/endocrine-surgery/thyroid-radiofrequency-ablation-rfa

EVIDENCE SUMMARY

A systematic search was conducted in scientific databases such as Ovid and PubMed up to May 2025 using these search terms: microwave ablation, radiofrequency ablation, thyroid nodule, thermal ablation. Filters English language, human studies, in the past 10 years were applied. A total of four relevant articles were included in this review, including four systematic reviews, three involving meta-analysis and one with network meta-analysis.

EFFICACY/ EFFECTIVENESS

A systematic review and meta-analysis by Zufry and Hariyanto (2024) evaluated the comparative efficacy of radiofrequency ablation (RFA) and microwave ablation (MWA) in the treatment of benign thyroid nodules. The analysis included nine studies with a total of 2,707 nodules. The primary outcome assessed was the volume reduction ratio (VRR) at 1-, 3-, 6-, and 12-month follow-ups. Results indicated that both RFA and MWA showed similar volume reduction ratios (VRRs) at one month (standardized mean difference (SMD) 0.06; 95% confidence interval (CI): -0.13 to 0.26; p=0.52) and three months (SMD 0.11; 95% CI: -0.03 to 0.25; p=0.12). However, RFA demonstrated significantly greater VRRs at six months (SMD 0.25; 95% CI: 0.06 to 0.43; p=0.008) and 12 months (SMD 0.38; 95% CI: 0.17 to 0.59; p<0.001) compared to MWA. There were no significant differences between RFA and MWA in symptom scores, cosmetic scores. The authors concluded that RFA may offer a modest advantage over MWA in achieving sustained volume reduction in benign thyroid nodules over longer follow-up periods.[11]

A systematic review and meta-analysis by Qian et al. (2024) compared the effectiveness of MWA and RFA for the treatment of benign thyroid nodules six months after operation in elderly patients in terms of nodular volume reduction. The analysis included 2 RCTs involving 1,456 participants. The results showed no significant difference in the nodular volume reduction rate between the two ablation methods six months after operation (p=0.16; 95 % CI: 0.46 to 1.14).[12]

A systematic review and meta-analysis by Guo et al. (2021) compared the effectiveness of MWA and RFA for the treatment of benign thyroid nodules. The analysis included five studies involving 899 patients with 956 benign thyroid nodules treated with RFA and 869 patients with 938 benign thyroid nodules treated with MWA. Both techniques demonstrated significant volume reduction, with comparable VRRs at 3 months (56.0% vs. 53.9%, p=0.668) and 6 months (80.8% vs. 74.9%, p=0.080). However, RFA showed a statistically higher VRR than MWA at 12 months (86.2% vs. 80.0%, p=0.036), suggesting a potential advantage in long-term volume reduction. Symptom and cosmetic scores improved significantly in both groups at 6 and 12 months, with no significant differences between the two modalities.[4]

A systematic review and network meta-analysis by Sun et al. (2024) evaluated the relative effectiveness of four ultrasound-guided ablation techniques, which included, RFA, MFA, laser ablation and high-intensity focused ultrasound, for treating benign thyroid nodules. The analysis included 35 studies with 5,655 patients. Results showed that RFA of two sessions exhibited the best outcomes at six months for percentage change in volume (surface under the cumulative ranking curve (SUCRA) value 74.6), closely followed by RFA (SUCRA value 73.7). At 12 months, RFA was identified as the most effective (SUCRA value 81.3). Subgroup analysis showed RFA2 as the most effective for solid nodule volume reduction at 6 months (SUCRA value 75.6). The authors concluded that while all techniques showed clinical benefit, RFA was associated with the most consistent and substantial nodule shrinkage.[13]

SAFETY

According to the Ministry of Health guidelines on the use of RFA therapy for chronic pain, the devices and related equipment used for RFA must be approved and certified by the Medical Device Authority (MDA) of the Ministry of Health.[14] Similarly, any MWA system must also receive approval and certification from the MDA.

In the systematic review and meta-analysis by Zufry and Hariyanto (2024), there were no statistically significant differences in safety outcomes between the two techniques across the nine included studies in terms of major complications (OR 0.87; 95% CI: 0.63 to 1.20; p=0.41), haemorrhage/haematoma (OR 1.41; 95% CI: 0.81 to 2.47; p=0.22), hoarseness/voice change (OR 0.73; 95% CI: 0.47 to 1.14; p=0.17), skin burn (OR 1.03; 95% CI: 0.22 to 4.94; p=0.97), cough (OR 0.60; 95% CI: 0.07 to 4.92; p=0.64), and sympathetic nerve injury (OR 0.47; 95% CI: 0.08 to 2.76; p=0.40). The authors concluded that both RFA and MWA have comparable safety profiles.[11]

The systematic review and meta-analysis by Qian et al. (2024) compared the incidence of major complications of RFA versus MWA in treating benign thyroid nodules. Major complications included persistent or temporary hoarseness, postoperative hypothyroidism/hypoparathyroidism or hyperthyroidism, brachial plexus injury, and dysphagia; secondary complications included bleeding, vomiting, skin burns, fever, local infection, and severe pain requiring drug treatment. The analysis included 2 RCTs involving 1,456 participants. The results showed no significant difference in comparing the incidence of major complications between the two ablation methods (p=0.22; 95 % CI: -4.51 to 1.06).[12]

Based on the systematic review and meta-analysis by Guo et al. (2021), the major complications reported for RFA primarily included transient voice change (35 cases) and nodule rupture (two cases). For MWA, major complications were slightly more frequent and included transient voice change (44 cases), nodule rupture (four cases), and sympathetic nerve injury (2 cases). In terms of minor complications, RFA was associated with 40 cases of haemorrhage or hematoma, while MWA recorded 33 cases of haemorrhage or hematoma, along with one case each of skin burn, vomiting, and hyperthyroidism. Despite these events, the overall complication rates for both modalities were low, and no statistically significant differences were found between RFA and MWA in terms of either major (p=0.107) or minor (p=0.661) complications.[4]

COST-EFFECTIVENESS

There was no retrievable evidence related to the cost-effectiveness of MWA and RFA in the treatment of benign thyroid nodules. There were no studies reporting data on direct or indirect costs associated with MWA and RFA. While there is a lack of data regarding costs specific to MWA and RFA respectively, a recent cost analysis within the Italian healthcare system shows thermal ablation to be a cost-effective alternative compared to surgical options. This analysis highlighted significant cost savings with thermal ablation (€1,560.06), particularly due to reduced hospital stay and lower indirect costs. Thermal ablation incurred lower costs compared to total thyroidectomy (€5,185.36) and hemithyroidectomy (€4,211.92).[15]

CONCLUSION

Based on the review, both RFA and MWA are effective and safe minimally invasive treatment options for benign thyroid nodules. RFA demonstrates a superior volume reduction ratio at 12 months compared to MWA, while complication rates, symptom improvement, and cosmetic outcomes are comparable between the two modalities. Thermal ablation techniques, including RFA and MWA, also offer significant cost savings over traditional surgical approaches, largely due to reduced hospitalization and indirect costs. However, current local clinical guidelines only incorporate evidence up to 2017, and neither RFA nor MWA were considered during their development. Both modalities may merit inclusion in future guideline updates.

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