**Name of Journal:** *World Journal of Clinical Cases*

**Manuscript NO:** 42303

**Manuscript Type:**ORIGINAL ARTICLES

***Clinical Trials Study***

**Comparative study on operative trauma between microwave ablation and surgical treatment for papillary thyroid microcarcinoma**

Xu B *et al*. Ablation and surgical treatment for papillary thyroid microcarcinoma

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**Author contributions:** Xu B and Zhou NM designed research; Xu B and Cao WT performed research; Gu SY contributed new analytic tools; Xu B analyzed data; and Xu B, Zhou NM and Cao WT wrote the paper.

**Support by** Minhang District Natural Science Research Project, NO. 2013MHZ003.

**Institutional review board statement:** The study was approved by the Ethics Committee of Fudan University Affiliated Shanghai Fifth People’s Hospital.

**Clinical trial registration statement:** This study is registered at Chinese Clinical Trial Registry. The registration number is ChiCTR1800018512.

**Informed consent statement:** All patients gave informed consent to this study.

**Conflict-of-interest statement:** The authors declare that they have no competing interests.

**Data sharing statement:** No additional data are available.

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**Manuscript source:** Unsolicited manuscript

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**Telephone:** +86-21-24289356

**Received:** September 27, 2018

**Peer-review started:** September 27, 2018

**First decision:** October 18, 2018

**Revised:** October 25, 2018

**Accepted:** November 7, 2018

**Article in press:**

**Published online:**

**Abstract**

***AIM***

To compare the effect and postoperative trauma of ultrasound-guided percutaneous microwave ablation and surgical resection in the treatment of papillary thyroid microcarcinoma (PTMC).

***METHODS***

Eighty-seven patients with PTMC in Fudan University affiliated Shanghai Fifth People’s Hospital were enrolled as subjects. The patients were divided into microwave ablation group (41 cases) and surgical group (46 cases). The operation time, intraoperative blood loss, length of hospital stay, serum C-reactive protein (CRP), interleukin-6 (IL-6), tumor necrosis factor-α (TNF-α), thyroid-related hormonal changes and complications 7 d and 30 d after surgery were observed.

***RESULTS***

The operation time, intraoperative blood loss and length of hospital stay in the surgical group were significantly higher than those in the microwave ablation group. The levels of CRP, IL-6 and TNF-α in the surgical group were significantly higher than those in the microwave ablation group (all *P* < 0.05). The free triiodothyronine (FT3) and free thyroxin (FT4) levels in the surgical group were significantly lower than those in the microwave ablation group. However, the postoperative thyroid stimulating hormone (TSH) levels were significantly higher than those in the microwave ablation group (*P* < 0.05). The interaction showed that there were interactions between the FT3, FT4, and TSH 7 d and 30 d after operation and the treatment methods. The differences were statistically significant (all *P* < 0.05). There was no significant difference in the complications between the two groups (*P* > 0.05).

***CONCLUSION***

Microwave ablation for papillary microcarcinoma of the thyroid gland has fewer traumas to the body, quicker recovery, and no scars. It can effectively shorten the length of hospital stay and improve the quality of life of patients.

**Key words:** Microwave ablation; Papillary thyroid microcarcinoma; Thyroidectomy; Body trauma; Ultrasound

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**Core tip:** Although thyroidectomy is the standard treatment for papillary thyroid microcarcinoma (PTMC), it causes great trauma to the patient's body. In recent years, there have been reports on microwave ablation for patients with PTMC, but the efficacy is not certain. This study aims to compare the efficacy and the impact on body trauma using ultrasound-guided percutaneous microwave ablation for PTMC and surgical resection. The results showed that microwave ablation for PTMC has less trauma, quick recovery and no scar, which can effectively shorten the hospitalization time and improve the quality of life.

Xu B, Zhou NM, Cao WT, Gu SY. Comparative study on operative trauma between microwave ablation and surgical treatment for papillary thyroid microcarcinoma. *World J Clin Cases* 2018; In press

**INTRODUCTION**

With the popularization use of thyroid ultrasonography and the wide application of ultrasound-guided fine needle aspiration, the detection rate of papillary thyroid microcarcinoma (PTMC) is increasing over time[1,2]. At present, thyroidectomy is still the standard treatment method. However, the patient's physical and psychological trauma caused by surgery is extremely high. Hemorrhage during the operation may easily damage the adjacent vital structures such as the parathyroid gland and the recurrent laryngeal nerve, causing complications such as hoarseness after surgery leading to greater damage to the patient[3-5]. With the rapid development of minimal invasive techniques, ultrasound-guided microwave ablation has the advantages of small injury, short treatment time, effective curative effect, little effect on the surrounding structure and patient appearance, rapid recovery after ablation, no need for lifelong medication, *etc*. And it is mainly used for thyroid treatment of benign nodules[6-8]. In recent years, microwave ablation has also been reported for some patients with PTMC and achieved good results[9-11]. However, the current clinical value of ultrasound-guided microwave ablation for PTMC has not yet reached a consensus and it cannot be accurately judged whether this new treatment can replace traditional surgery. Therefore, the present study aims to provide ultrasound-guided percutaneous microwave ablation of PTMC versus surgical resection and its impact on body trauma.

**MATERIALs AND METHODS**

***General information***

Totally 87 patients with PTMC diagnosed by ultrasound guided fine-needle aspiration biopsy (FNAB) in Fudan University Affiliated Shanghai Fifth People’s Hospital from January 2012 to October 2017. The maximum diameter of nodules was less than 1.0 cm. Microwave ablation or surgery is selected based on the patient's own condition and their wishes. The microwave ablation group consisted of 41 patients including 12 males and 29 females and aged from 24 to 65 years with an average age of (45.11 ± 7.28) years (Table 1). Inclusion criteria: (1) Papillary microcarcinoma of thyroid gland confirmed by FNAB; (2) Maximum tumor diameter ≤ 1.0 cm, no close to the capsule (distance > 2.0 mm), no obvious abnormality of contralateral thyroid gland, no large neck lymphadenopathy or metastatic lymph nodes; (3) Ultrasound imaging has a clear needle path; and (4) Patients with severe heart and lung diseases, poor general condition which cannot tolerate surgery or reject the surgery and those who are anxious about the disease for treatment.

***Instrument***

GE Voluson E8 ultrasound diagnostic device with line array probe (frequency from 5 to 10 MHz) were used. Microwave ablation apparatus: Nanjing Kangyou KY-2000 microwave ablation instrument and the frequency is 2450 MHz with continuous adjustable output power from 10 to 100 W. Microwave ablation instrument is connected with 16 G cold-cycle Thy-ablation microwave antenna through low loss coaxial cable.

***Surgical methods***

**Surgery group:** A 5 cm long transverse incision was made 2 cm above the sternal fossa. Radical resection of the affected side of the PTMC (the affected side of the thyroid and isthmus resection + lymph node dissection of the affected side VI). Negative pressure drainage was performed after surgery.

**Microwave ablation group:** After the patient was intubated with general anesthesia, the patient was kept in a supine position. The saline was injected around the thyroid capsule according to the location of the tumor to form a "liquid barrier." After ultrasound guided percutaneous puncture, the microwave antenna was placed into the tumor (Figure 1). The ablation power was set to 50 W and the ablation time was set to 60-300 s. Extensive ablation of the tumor was performed. After the tumor was ablated, the ablation needle was slowly withdrawn to prevent the tumor cells from being transplanted along the needle path. Ultrasound angiography was used postoperatively to determine if ablation was complete (Figure 2).

***Observation indicators***

The operation time, intraoperative loss blood volume, length of hospital stay, serum C-reactive protein (CRP), interleukin-6 (IL-6) and tumor necrosis factor-α (TNF-α) 24 h after operation, thyroid hormone-related changes and complications 7 d and 30 d after operation were observed.

***Statistical analysis***

SPSS19.0 software was used for data analysis. Measured data were expressed as mean ± SD and the two groups were compared using an independent sample *t-*test method. The number of cases or percentages of count data is expressed and comparison between the two groups is performed using the *χ*2 test. Repeated measures analysis of variance was used to compare the levels of hormones [T3, T4, thyroid stimulating hormone (TSH)] preoperatively, 7 d after surgery and 30 d after surgery. *P* < 0.05 was considered statistically significant.

**RESULTS**

***Comparison of two groups’ clinical indicators***

The surgical time, blood loss volume and length of hospital stay in the surgical group were significantly higher than those in the microwave ablation group (*P* < 0.05) (Table 2).

***Comparison of postoperative serum markers in the two groups***

The levels of CRP, IL-6 and TNF-α in the surgical group were significantly higher than those in the microwave ablation group (*P* < 0.05) (Table 3).

***Comparison of thyroid hormone index before, 7 d after operation and 30 d after operation in two groups***

The hormone levels of the two groups (including the three hormone levels of T3, T4, and TSH) were recorded before surgery, 7 d after surgery and 30 d after surgery (Tables 4, 5 and 6 and Figure 3). According to preoperative data analysis, there was no significant difference in thyroid hormone levels between the microwave ablation group and the surgery group (*P* > 0.05). Repeated measurement analysis of variance within the group found that free triiodothyronine (FT3) levels of subjects decreased from preoperative to postoperative and the difference was statistically significant (*P* < 0.05). Subjects' TSH levels increased significantly from preoperative to postoperative and the difference was statistically significant (*P* < 0.05). Subjects’ free thyroxin (FT4) levels had no significant changes from preoperative to postoperative and the difference was not statistically significant (*P* < 0.05). Comparison between groups revealed that the FT3 and FT4 levels in the surgery group were significantly lower than those in the microwave ablation group (*P* < 0.05). The postoperative TSH levels were significantly higher than those in the microwave ablation group. The difference was statistically significant (*P* < 0.05). The interaction revealed that there were interactions between the 7 d and 30 d postoperative FT3, FT4, and TSH changes and the treatment plan, and the difference was statistically significant (all *P* < 0.05).

***Comparison of complications in patients***

In the recovery process of the two groups, patients had different degrees of pharyngeal discomfort, hoarseness, pain, parathyroid injury, incision infection and other complications. Those patients returned to normal after 3 mo. There were no significant difference in the complications between the two groups (*P* > 0.05). (Table 7)

**DISCUSSION**

The direction of modern surgical development is minimal invasive treatment that is to achieve the purpose of treatment with minimal surgical trauma and to minimize the impact of surgical trauma on the body. At present, the standard treatment for single PTMC is still surgical lobectomy, which is unacceptable to some patients because of its disadvantages such as large trauma, long recovery time, and medication for life[12-15]. Given that papillary thyroid cancer has "moderate" biological behavior, it is slow growing and some patients carry no progress during their lifetime. Therefore, it is particularly necessary to find a therapeutic method that is effective, safe, minimally invasive and more aesthetically pleasing. Microwave ablation is guided by ultrasound into the target tissue of the microwave ablation electrode the target tissue by rapid hyperthermia coagulation necrosis, necrotic tissue will be absorbed by the body over time and ultimately achieve the purpose of treatment with the advantages as minimal trauma, rapid recovery, easy to use, *etc*[16-19]. This study compared ultrasound-guided percutaneous microwave ablation and surgical resection of PTMC and its impact on body trauma in order to explore the clinical value of ultrasound-guided microwave ablation of PTMC.

The surgical time, intraoperative blood loss volume and length of hospital stay in the surgery group were significantly higher than those in the microwave ablation group (*P* < 0.05). It indicated that microwave ablation of PTMC can significantly reduce the trauma to the patient. It is known that microwave ablation and surgical trauma as a kind of external environmental stimuli can both cause the body's non-infectious stress response. The size and duration of stress response after surgery reflect the severity of surgical trauma[20,21]. Therefore, lower trauma during surgery can reduce the body's stress response. In terms of reflecting the stress response of the body, it is known that CRP is synthesized by the liver and can be significantly elevated under stress conditions. The more severe the trauma, the more obvious the increase of CRP[22,23]. IL-6 is a multi-functional cytokine that is mainly produced by monocytes/macrophages and T cells and is extremely low in normal human plasma. Many pathological factors can affect the production of IL-6. Surgical trauma is one of the important factors. IL-6 is now considered to be a sensitive index of reactive tissue damage[24,25]. Similarly, TNF-α can be used as a marker to analyze the secretion of cytokines and is a sensitive marker for early trauma in tissues[26,27]. In this study, the level of stress response of postoperative patients was more accurately measured by measuring the level of these three indicators in postoperative patients. The results revealed that the levels of CRP, IL-6 and TNF-α in the surgical group were significantly higher than those in the microwave ablation group at 24 h after operation (*P* < 0.05). The stress response of the patients in the surgery group was even stronger, and the microwave ablation surgery significantly reduced the patient's body trauma. This is because ultrasound-guided microwave ablation is guided by ultrasound under real-time guidance and avoids major organs such as large blood vessels in the puncture path. The microwave ablation electrode is rapidly and accurately implanted in the thyroid tumor lesions for ablation. It has the advantages of simple operation, short time, less intraoperative blood loss and less traumatic emergency response[28,29]. Those can prompt the restore of the patient’s health as soon as possible, shorten the patient's hospitalization time and improve the patient's quality of life.

As a surgical treatment of PTMC, changes in the thyroid function of the patient should cause extra attention. In this study, thyroid hormone levels were measured before, 7 d after surgery and 30 d after surgery in patients with microwave ablation and surgery. And thyroid function was dynamically monitored in each patient to better reflect postoperative dynamic changes of the thyroid function of the patient. Repeated-measures analysis of variance revealed that the FT3 and FT4 levels in the surgical group had a significant decrease after surgery, and the TSH increased significantly. Considering that most of the thyroid tissue was removed by surgery, the patient lost some of the endogenous thyroid function. The patient revealed a more obvious performance of hypothyroidism. In the microwave ablation group, the level of TSH slightly decreased after surgery, but the change was not obvious and there was no significant increase after surgery for a long time. This indicates that microwave ablation can better protect normal thyroid tissue than surgical resection, which is similar to the study of Baek *et al*[30]. It is worth noting that there was no significant change in the FT3 and FT4 levels on the 7th and 30th days after surgery in the microwave ablation group compared with the surgical group. This indicates that microwave ablation is relatively infrequent in the thyroid. Thyroid function still maintained at a certain level after surgery and no significant reduction in thyroid function occurred. This has important implications for patients in the clinic. If the patient's thyroid function remains stable after surgery, long-term use of thyroid hormone drugs can be avoided and the quality of life of patients can be improved.

The incidence of postoperative complications was observed in the study. The results revealed that postoperative complications occurred in 2 out of 41 patients who underwent microwave ablation. The overall incidence of complications was 4.9%. The overall incidence of complications in the comparison surgery group was 15.2%. But there was no significant difference between the two groups (*P* > 0.05). Considering that the sample size was small in this study, the difference was not obvious and large sample data was also needed. Long-term efficacy and complications were further observed.

In summary, the use of microwave ablation for the treatment of PTMC has little risk of traumatic stress and safety. This technology can effectively shorten the length of hospital stay and improve the quality of life of patients. Due to the small damage caused by microwave ablation, the postoperative thyroid function was not significantly affected, which has a high clinical value.

**ARTICLE HIGHLIGHTS**

***Research background***

The detection rate of papillary thyroid microcarcinoma (PTMC) has increased over time. Because thyroidectomy is prone to various complications, it can cause physical and mental harm to the patient. With the rapid development of minimally invasive techniques, microwave ablation is the main method of minimally invasive thyroid treatment, and is often used for the treatment of benign thyroid nodules. However, whether this method is used for the treatment of patients with PTMC is still not uniform.

***Research motivation***

In this study, microwave ablation was used to treat patients with PTMC. It is hoped that microwave ablation can achieve the same effect as thyroid surgery, and it can reduce the complications caused by thyroid surgery.

***Research objectives***

The aim of this study is to compare the efficacy of thyroidectomy and microwave ablation in the treatment of PTMC and the trauma effect on the patient's body, to find a more appropriate treatment for patients.

***Research methods***

Eighty-seven patients diagnosed with papillary thyroid carcinoma were enrolled. There were 46 cases in the surgical group and 41 cases in the microwave ablation group. Microwave ablation and thyroidectomy were performed in each group. The operation time, intraoperative blood loss, hospitalization time, serum c-reactive protein (CPR), interleukin-6 (IL-6) and tumor necrosis factor-α (TNF-α) were observed in the two groups. The changes of thyroid-related hormones and the postoperative complications of the two groups were observed 7 d after surgery and 30 d after surgery.

***Research results***

The operation time, intraoperative blood loss, hospitalization time, CPR, IL-6 and TNF-α in the surgical group were significantly higher than those in the microwave ablation group. The free triiodothyronine (FT3) and free thyroxin (FT4) levels in the surgical group were significantly lower than those in the microwave ablation group, while thyroid stimulating hormone (TSH) was significantly higher than the microwave ablation group. The complications of the two groups were similar, and the difference was not statistically significant.

***Research conclusions***

 Microwave ablation for the treatment of PTMC has less stress response and higher safety. It can effectively shorten the hospitalization time of patients and improve the life quality. The thyroid function of patients after operation is not affected, so microwave ablation treatment of PTMC has a high clinical value.

***Research perspectives***

With the development of minimally invasive treatment, minimally invasive treatment methods are increasingly applied to various diseases, so that patients can achieve therapeutic goals with minimal surgical trauma, and minimize the impact of surgical trauma on the body. Minimally invasive surgery is a new technological innovation that still requires large sample and multi-center clinical research support to evaluate long-term safety and efficacy.

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**P-Reviewer:** Arisawa T, Kim ES, Knittel T

**S-Editor:** Wang JL **L-Editor: E-Editor:**

**Specialty type:** Medicine, research and experimental

**Country of origin:** China

**Peer-review report classification**

Grade A (Excellent): 0

Grade B (Very good): B, B

Grade C (Good): C

Grade D (Fair): 0

Grade E (Poor): 0

**Figure 1**

**Figure 1 Ultrasound image of microwave ablation of thyroid tumors.**

**Figure 2**

**Figure 2 Two-dimensional and contrast-enhanced ultrasound images (no lesions intensified, completely ablated).**

**A**

**CY773 Figure 3**

**B**

**CY773 Figure 4**

**C**

**CY773 Figure 5**

**Figure 3 Trend of free triiodothyronine (A), free thyroxin (B) and thyroid stimulating hormone levels before treatment, 7 d and 30 d after treatment.** FT3: Free triiodothyronine; FT4: Free thyroxin; TSH: Thyroid stimulating hormone.

**Table 1 Comparison of general clinical data between two groups of patients**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Group** | **Case** | **Age (yr)** | **Gender** | | **Maximum diameter of nodule (mm)** |
| **Male** | **Female** |
| Surgery group | 46 | 46.2 ± 11.5 | 16 | 30 | 8.13 ± 1.22 |
| Microwave  Ablation group | 41 | 45.8 ± 10.2 | 12 | 29 | 8.87 ± 1.01 |
| *t*/*X*2 value |  | 0.171 | 0.302 | | -3.061 |
| *P* value |  | 0.865 | 0.583 | | 0.003 |

**Table 2 Comparison of clinical indicators between the two groups (mean ± SD)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Group** | **Case** | **Length of hospital stay (d)** | **Blood loss volume (mL)** | **Surgical time (min)** |
| Surgery group | 46 | 4.18 ± 0.55 | 33.12 ± 5.07 | 78.81 ± 12. 19 |
| Microwave  Ablation group | 41 | 1.77 ± 0.71 | 10.32 ± 1.65 | 25.02 ± 4. 14 |
| *t* value |  | 17.832 | 27.511 | 26.892 |
| *P* value |  | 0.000 | 0.000 | 0.000 |

**Table 3 Comparison of postoperative serum markers (mean ± SD)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Group** | **Case** | **CRP (mg/L)** | **IL-6 (ng/L)** | **TNF-α (ng/L)** |
| Surgery group | 46 | 12.05 ± 2.57 | 14.44 ± 4.61 | 51.39 ± 2.86 |
| Microwave  Ablation group | 41 | 0.71 ± 0.39 | 4.02 ± 1.78 | 43.55 ± 5.03 |
| *t* value |  | 27.951 | 13.591 | 9.059 |
| *P* value |  | 0.000 | 0.000 | 0.000 |

CRP: C-reactive protein; IL-6: Interleukin-6; TNF-α: Tumor necrosis factor-α.

**Table 4 Comparison of free triiodothyronine levels between the two groups before treatment, 7 d and 30 d after treatment**

|  |  |  |  |
| --- | --- | --- | --- |
| **FT3 (pmol/L)** | **Preoperative** | **7 d after surgery** | **30 d after surgery** |
| Microwave ablation group | 4.28 ± 0.49 | 4.25 ± 0.45 | 4.22±0.53 |
| Surgery group | 4.33 ± 0.78 | 3.09 ± 0.64 | 2.78±0.84 |

Fintra-group = 6.435, Pintra-group = 0.000; Finter-group = 8.546, Pinter-group = 0.000; Finteraction = 45.291, Pinteraction = 0.000. FT3: Free triiodothyronine.

**Table 5 Comparison of free thyroxin levels before and after treatment in 7 d and 30 d after treatment**

|  |  |  |  |
| --- | --- | --- | --- |
| **FT4 (pmol/L)** | **Preoperative** | **7 d after surgery** | **30 d after surgery** |
| Microwave ablation group | 12.33 ± 1.51 | 12.87 ± 2.66 | 12.67±2.83 |
| Surgery group | 12.72 ± 1.68 | 10.77 ± 2.25 | 9.45±2.07 |

Fintra-group = 0.866, Pintra-group = 0.221; Finter-group = 9.257, Pinter-group = 0.000; Finteraction = 31.378, Pinteraction = 0.000. FT4: Free thyroxin.

**Table 6 Comparison of thyroid stimulating hormone levels between the two groups before treatment, 7 d and 30 d after treatment**

|  |  |  |  |
| --- | --- | --- | --- |
| **TSH (mIU/L)** | **Preoperative** | **7 d after surgery** | **30 d after surgery** |
| Microwave ablation group | 2.11 ± 1.47 | 1.42 ± 0.91 | 1.08 ± 1.35 |
| Surgery group | 2.09 ± 1.01 | 13.44 ± 2.37 | 18.43±2.67 |

Fintra-group = 55.165, Pintra-group = 0.221; Finter-group = 67.234, Pinter-group = 0.000; Finteraction = 75.443, Pinteraction = 0.000. TSH: Thyroid stimulating hormone.

**Table 7 Comparison of postoperative complications in patients**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Group** | **Microwave ablation group (*n*=41)** | **Surgery group (*n*=46)** | ***X*2** | ***P*** |
| Pharyngeal discomfort | 0 | 1 | 1.508 | 0.219 |
| Hoarseness | 1 | 2 |
| Pain | 0 | 1 |
| parathyroid injury | 0 | 0 |
| Incision infection | 0 | 1 |
| Cough after drinking water | 1 | 2 |
| Incidence of complications | 4.9% | 15.2% |