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A Comparative Study of Ultrasound-Guided Microwave Ablation, Surgery and Rotational Adenomammectomy for Benign Breast Nodules

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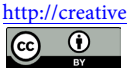

Abstract

Objective: To explore the clinical effects of conventional surgery, ultrasound-guided microwave ablation and rotational adenomammectomy on the prognosis of benign breast nodules. **Methods:** 232 cases of patients with benign breast nodules confirmed by pathological examination who received surgical treatment in the breast surgery department of our hospital from December 2016 to December 2020 were included. According to the surgical methods, they were divided into microwave ablation group (n = 48), conventional surgery group (n = 105) and rotational adenomammectomy group (n = 79). The clinical parameters were compared and analyzed between the three groups, and the postoperative pain, residual tumor, breast beauty and complication rate of the patients were evaluated. **Results:** Operative time, intraoperative blood loss, healing time and postoperative pain in microwave ablation group were lower than those of rotational adenomammectomy group ($P < 0.05$) and those of conventional surgery group ($P < 0.05$). Besides, those in the rotational adenomammectomy group were lower than those in the conventional surgery group ($P < 0.05$). The residual tumor rates in microwave ablation group and rotational adenomammectomy group were 4.17% and 3.80%, respectively. And the difference was not statistically significant ($P > 0.05$). Both of them were lower than 6.66% in conventional surgery group, with statistically significant differences ($P < 0.05$). The effective rates of breast beauty were 91.67%, 82.28% and 68.58% in the microwave ablation group, the rotational adenomammectomy group and the conventional surgery group, respectively. And the difference between groups was statistically significant ($P < 0.05$). The rate of postoperative complications in microwave ablation group and rotational adenomammectomy group were 4.17% and 3.80% respectively, both of which were significantly lower than 6.66% in conventional surgery group ($P < 0.05$). **Conclusion:** Microwave ablation, rotational adenomammectomy and

conventional surgery are effective for the treatment of benign breast tumors. Among them, microwave ablation is the best option with many advantages of shorter operative time, less intraoperative blood loss, more beautiful breast shape, less postoperative pain, a lower residual rate after surgery, and a lower complication rate.

Keywords

Benign Breast Nodules, Microwave Ablation, Surgical Operation, Rotational Adenomammectomy, Prognosis

1. Introduction

Benign breast nodules are a common clinical breast disease. In recent years, the incidence rate of breast benign lesions has been increasing year by year, accounting for 60% - 85% [1] [2] in all breast diseases. For many years, the most effective treatment for benign breast tumor is surgical resection. In recent years, with the continuous improvement of women's aesthetic requirements, how to narrow the surgical incision, reduce postoperative complications, maintain the beauty of the breast, and achieve the purpose of treatment has become a research hotspot in breast surgery. McMurdo rotational adenomammectomy [3] is widely used for the treatment of benign breast nodules, which has the characteristics of less trauma, faster healing and good results, but there are still complications such as tumor residue and postoperative hematoma [4]. In recent years, along with the further development of minimally invasive concept, microwave ablation has been gradually applied to the treatment of tumors with ideal efficacy, but its use in the treatment of benign breast tumors has been less reported. Based on this, this study systematically analyzed and evaluated the effects of microwave ablation, surgery and rotational resection for the treatment of benign breast nodular tumors through a clinical control study, which is reported as follows.

2. Materials and Methods

2.1. Clinical Data

232 patients with benign breast nodules treated by elective surgery in breast surgery in our hospital from December 2016 to December 2020 were used as the study population. Inclusion criteria: 1) female, diagnosed by imaging and pathological examination, meeting the diagnostic criteria of benign nodules; 2) meeting the indications for surgery; 3) volunteering to choose the surgical method and agreeing to surgery; 4) nodules within 3 cm in diameter [5]; 5) being able to cooperate with postoperative follow-up and review. Exclusion criteria: 1) other breast lesions, malignant tumors; 2) coagulation mechanism disorders, liver and kidney insufficiency; 3) pregnancy and lactation; 4) inability to complete follow-up. The study was approved by the hospital ethics committee. The

patients were divided into three groups according to the different surgical methods. The microwave ablation group: age 23 - 50 years, average (37.1 ± 5.2) years; nodule diameter 1 - 3 cm, average (1.7 ± 0.3) cm; 32 single cases, 16 multiple cases; surgical group: age 21-53 years, average (37.5 ± 5.6) years; nodule diameter 2 - 3 cm, average (2.1 ± 0.2) cm; 79 single cases, 26 multiple cases In the rotational adenomammectomy group, the age ranged from 21 to 55 years, with a mean of (38.1 ± 6.2) years; the nodule diameter ranged from 1 to 3 cm, with a mean of (1.9 ± 0.2) cm; there were 51 single cases and 28 multiple cases. The differences in age, nodule diameter, and number of nodules among the three groups were not statistically significant ($P > 0.05$).

2.2. Methods

1) Surgical group: In this group, conventional excision of benign breast nodules was performed, and preoperative ultrasound was performed to locate and mark the nodule location. After local anesthesia with lidocaine, the skin and gland of the affected breast were cut, the nodules were removed and sutured layer by layer.

2) Rotational adenomammectomy group: This group was treated with mammotome minimally invasive circumcision. The micromotor minimally invasive rotational adenomammectomy system and 8 g rotational adenomammectomy knife were used. Preoperative ultrasound examination was performed to clarify the size, number and location of the nodules and the direction of needle entry. The needle was then inserted into the junction of the nodule and normal tissue under ultrasound guidance, and the rotational adenomammectomy (fan-shaped) was performed according to the ultrasound prompt until the echogenicity of the nodule disappeared.

3) Microwave ablation group: microwave ablation was performed in this group. The microwave ablation instrument with a frequency of 2450 MHz, 18 G disposable microwave ablation needle and ARIETTA 70 color Doppler ultrasound diagnostic instrument with a probe frequency of 8 - 13 MHz were applied. In the supine position, the affected breast was exposed, the location, number and size of the nodule were checked, and localized and marked to determine the puncture location and direction. 1% lidocaine was used for local anesthesia, and the masses were ablated one by one and at multiple points under the guidance of color ultrasound, with an output power of 40 W. The ablation time of each mass was 30 - 180 s. After the mass was fully covered by heat-generated strong echo, ablation was stopped and ultrasound contrast agent was injected through the vein, and there was no perfusion in the nodal area, that is, ablation was complete, and ablation continued on the contrary. The tip of the puncture needle must be in the ultrasound observable range during the procedure, moving the ablation and avoiding the nipple. For those within 0.5 cm from the skin, posterior space and areola, 0.9% sodium chloride solution should be injected to increase the tissue thickness for water isolation to prevent burning the adjacent tissues. Skin temperature should be paid attention

to during the operation, and ice should be applied immediately after the operation for 30 min without pressure bandaging.

2.3. Observation Indexes

1) Surgery: the operation time, intraoperative bleeding, postoperative healing time of the two groups were recorded, and the visual analog method (VAS) was applied to assess the pain degree in the postoperative area, with 0 - 10 points, and the scores were as follows: 1 - 3 for mild pain, 4 - 6 for moderate pain, and 7 - 10 for severe pain.

2) Residual swelling: The residual swelling in the operated area was observed by breast ultrasound review at 3 months postoperative follow-up.

3) Aesthetics of the operated area: the postoperative breast aesthetics were evaluated according to the Harris criteria [6] [7] [8]: excellent, both breasts are symmetrical, no significant difference, and scar is not obvious and difficult to detect; good, both breasts have some difference in appearance and scar is significant; medium, both breasts have significant difference in appearance and are asymmetrical, scar is obvious; poor, both breasts have significant difference in appearance and scar is significant, with contracture, hardening and other discomfort, excellent situation was counted.

4) Complication situation: after the operation, the patients were observed the occurrence of complications, mainly skin redness, skin pigmentation, breast pain, incision infection, fat liquefaction, etc.

2.4. Statistical Processing

SPSS22.0 software was applied for analysis and processing. Normally distributed measurement data were analyzed by ($\overline{x} \pm s$), and the LSD-t test was used for comparison between groups, while the count data were expressed as the number of cases (%), and the chi-square test between groups, with $P < 0.05$ indicating the possession of statistical differences.

3. Results

3.1. Comparison of Clinical Procedures

The operating time, intraoperative bleeding, healing time and postoperative pain in the microwave ablation group were lower than those in the minimally invasive rotational adenomammectomy group and the surgical group, while the minimally invasive rotational adenomammectomy group was lower than the conventional surgical group, and the difference was statistically significant ($P < 0.05$), as shown in Table 1.

3.2. Comparison of Postoperative Mass Residuals

At the 3-month postoperative review, the difference in the residual mass rate was not statistically significant ($P > 0.05$) in the microwave ablation group and the minimally invasive rotational adenomammectomy group, but both were lower

than the surgical group, and the difference was statistically significant (P < 0.05), as shown in Table 2.

3.3. Comparison of Postoperative Breast Aesthetics

At 6-month postoperative follow-up, the excellent breast aesthetics rate of 91.67% in the microwave ablation group was higher than that of 82.28% in the minimally invasive rotation group and 68.58% in the surgical group, and the difference between the groups was statistically significant (P < 0.05), as shown in Table 3.

3.4. Comparison of the Occurrence of Postoperative Complications

The postoperative complication rates were 4.17% and 3.80% in the microwave ablation group and minimally invasive rotational adenomammectomy group, respectively, and 6.66% in the surgical group, with statistically significant differences

Table 1. Comparison of clinical surgical conditions of patients in the three groups ($\bar{x} \pm s$).

Group	Number of cases	Operating time (min)	Intraoperative bleeding volume (mL)	Healing time (d)	Postoperative pain level (min)
Microwave ablation group	48	42.72 ± 11.36	2.72 ± 0.81	2.84 ± 0.74	1.74 ± 0.43
Rotational adenomammectomy group	79	60.81 ± 14.53	5.29 ± 1.34	3.91 ± 0.85	2.15 ± 0.84
Surgical group	105	78.75 ± 13.06	14.05 ± 2.74	5.50 ± 1.36	5.03 ± 1.25
T		16.172	9.336	14.062	5.694
P-value		0.020	0.001	0.001	0.001

Table 2. Comparison of postoperative mass residuals in the three groups (n, %).

Group	Number of cases	Postoperative mass residue
Microwave ablation group	48	2(4.17)[a]
Rotational adenomammectomy group	79	3 (3.80)[b]
Surgical group	105	7 (6.66)

Note: [a]P < 0.05 (X^2 4.945) and [b]P < 0.05 (X^2 6.021) compared with the surgical group.

Table 3. Comparison of postoperative breast aesthetics among patients with different procedures (n, %).

Group	Number of cases	Excellent	Good	Moderate	Poor	Excellent rate
Microwave ablation group	48	29 (60.42)	15 (31.25)	4 (8.33)	0 (0)	44 (91.67)[ab]
Rotational adenomammectomy group	79	43 (54.43)	22 (27.82)	11 (13.92)	3 (3.80)	65 (82.28)[c]
Surgical group	105	40 (38.10)	32 (30.48)	23 (21.90)	10 (9.52)	71 (68.58)

Note: [a]P < 0.05 (X^2 9.164), [b]P < 0.05 (X^2 10.748) compared with the surgical group and [c]P < 0.05 (X^2 8.332) compared with the minimally invasive rotational adenomammectomy group.

Table 4. Comparison of postoperative complications in patients with different surgical procedures (n, %).

Group	Number of cases	Skin redness and swelling	Skin hyperpigmentation	Breast pain	Incision infection	Fat liquefaction	Total number of occurrences
Microwave ablation group	48	2 (4.17)	0	0	0	0	2 (4.17)[a]
Rotational adenomammectomy group	79	2 (2.53)	0	1 (1.27)	0	0	3 (3.80)[b]
Surgical group	105	3 (2.86)	1 (0.95)	1 (0.95)	2 (1.90)	0	7 (6.66)

Note: [a]$P < 0.05$ (X^2 3.362) and [b]$P < 0.05$ (X^2 5.704) compared with the surgical group.

($P < 0.05$), as shown in Table 4.

4. Discussion

At present, the effective method of clinical treatment of benign breast nodules is surgical resection. In recent years, along with the continuous improvement of women's aesthetic requirements for maintaining good breast shape, reducing surgical incision, reducing scar formation and so on [9] [10], treatment methods are also constantly improving. With the birth of minimally invasive technology, it can not only effectively treat benign tumors, but also meet women's aesthetic requirements.

The McMurdo rotational adenomammectomy is a minimally invasive technique commonly used in breast surgery, which is composed of vacuum suction pump and a rotational adenomammectomy knife. This operation has the characteristics of hidden incision, small scar, little influence on the appearance of breast, which can greatly reduce the psychological pressure of patients, but there are still some shortcomings such as bleeding and residual mass [11] [12]. It was found that ultrasound-guided microwave therapy is effective, mainly through high temperature so that the mass group length can be protein denaturation and coagulative necrosis in the shortest possible time [13]. Compared with traditional surgery, ultrasound-guided minimally invasive treatment has the advantages of accurate positioning, strong pertinence, local anesthesia, small trauma, effective and reliable, especially microwave ablation. Microwave ablation can not only achieve the same curative effect as minimally invasive rotational adenomammectomy and surgery, but also shorten the ablation time and reduce the pain [14]. In addition, microwave thermal effect can also enhance blood circulation in the edge area of ablation area, promote local tissue metabolism, improve nutrition, and accelerate tissue repair ability [13].

The results of this study showed that the operative time, intraoperative bleeding, healing time, and postoperative pain in the surgical area of patients in the microwave ablation group were lower than those in the minimally invasive rotational adenomammectomy group and the surgical group, which was considered to be related to the impact of the slow absorption of the postoperative area on the review. The rate of excellent postoperative breast aesthetics was significantly higher in the microwave ablation group than in the minimally invasive rotational adenomammectomy group and the conventional surgical group, indicating

that microwave ablation can restore breast beauty to the greatest extent. This is generally consistent with the reports of related studies. In this study, at the 3-month postoperative review, the residual rate of masses in the microwave ablation and minimally invasive rotational adenomammectomy groups were 4.0% and 3.80% respectively, which were lower than the 6.66% in the surgical group, and the difference was statistically significant ($P < 0.05$). Meanwhile, at 6-month postoperative follow-up, the excellent rate of breast aesthetics was 91.67% in the microwave ablation group, 82.28% in the rotational adenomammectomy group, and 68.58% in the surgical group, and the difference between the groups was statistically significant ($P < 0.05$). In addition, the postoperative complication rates were 4.17% and 3.80% in the microwave ablation group and the rotational adenomammectomy group, respectively, which were significantly lower than the 6.66% in the surgical group, and the difference was statistically significant ($P < 0.05$). From the results of this study, it is clear that the advantages of microwave ablation are as follows: first, high precision and safety, which can be accurately punctured by ultrasound real-time observation and reduce the damage to surrounding tissues, and the microwave ablation needle entry position, ablation power and time can be adjusted according to the nodule size. Second, microwave ablation is minimally invasive, fast recovery and scarless: compared with rotational adenomammectomy and surgery, the microwave ablation incision is small and no scar remains. Third, the scope of application is wide. Microwave ablation is more suitable for the treatment of multiple tumors and has good efficacy for larger diameter masses [13] [14] [15] [16].

5. Conclusion

Microwave ablation, surgery, and McMurdo rotational adenomammectomy are effective in the treatment of benign breast nodules. However, compared with the other two, microwave ablation has many advantages of longer absorption time, shorter operation time, less blood loss, no scar and less pain. But it still has some limitations, so we should choose the most suitable scheme according to the specific situation of benign breast nodules.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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