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Research Article

Analysis of the Curative Effect of Post-Radiation Otitis Media with Effusion by Using Electrotome Myringotomy

Yu-Liu^{1,*}, Yan-Li^{1,*}✉

¹The First School of Clinical Medicine, Yangtze University, Jingzhou, Hubei, 434023, China.

* These authors contributed equally.

✉ Correspondence

Yan-Li, The First School of Clinical Medicine, Yangtze University, Hubei, 434023, China. Email: 2603398910@qq.com. Telephone number: 18163138617.

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Abstract

Objective. The purpose of this study was to evaluate the efficacy of myringotomy by using electrotome in the treatment of post-radiation otitis media with effusion (OME). **Methods.** 30 subjects (46 ears) were enrolled from patients who were admitted to the First School of Clinical Medicine of Yangtze University, between January 2017 and April 2019, including 19 males and 11 females, aged 42-68 years old, with a course of disease ranging from 2 to 8 years. In all 46 ears, electrotome myringotomy was performed under the endoscope. We made a hole with a diameter of 4-6mm with an electrotome of 20W at the downside of the affected ear drum pars tensa, which can wash the tympanic cavity and clean the accumulated fluid in it. **Results.** A total of 46 ears in 30 patients underwent intervention. All patients were required to take the Eustachian Tube Dysfunction Questionnaire (EDTQ-7) and endoscope before surgery and per 3 months after surgery. At 6 months after the operation, 21 ears had significant efficacy and 17 ears had mild efficacy with 8 ears invalid. **Conclusion.** The electrotome is feasible for refractory OME, which can help patients alleviate symptoms and improve the quality of life effectively.

Key words: Nasopharyngeal Carcinoma (NPC); Radiotherapy (RT); Post-Radiation Otitis Media with Effusion; Electrotome. Myringotomy.

Introduction

The global incidence of NPC is 1.2 per 100,000 population with its peak incidence concentrated in South-East Asia and China (2.1–9.4 per 100,000 population) (1), especially in Guangdong province, Guangxi province, Fujian province and other southern provinces in China. Most tumors arise from the pharyngeal recess or from the posterosuperior wall (2), which is hidden and not easy to be detected early. The typical clinical presentations include epistaxis, cervical lymphadenopathy, nasal obstruction, headache, hearing impairment, diplopia, neurological symptoms of the brain and distant metastasis (3). Radiation is the primary treatment modality of nasopharyngeal carcinoma (NPC) (4). Post-radiation Otitis media with effusion (OME) is known the most persistent clinical outcome of radiotherapy (RT) for NPC patients and has been largely attributed to the deterioration of Eustachian tube function (5-7), which often requires patients return to hospital for treatment repeatedly. Radiation can produce conductive hearing loss through stenosis of the ear canal, thickening of the tympanic membrane (TM), or middle ear and eustachian tube (ET) changes producing serous otitis media (8). However, the curative effect of OME is often poor, and it has become a persistent secretory otitis media, which affects the life quality of patients seriously (9). The mainly traditional treatment is myringotomy and myringotomy with ventilation tube, which has higher complication rates of suppurative otitis media, otorrhea and obstruction tube (10). Furthermore, symptoms tend to recur easily after removing the tube (11). CO₂ laser tympanostomy has been applied in the treatment of OME for several years (12).

However, more than 90% of the patients' eardrums have healed within one month and the symptoms have relapsed (13-16). In addition, other researchers also point out that the possible blast injury caused by excessively high-powered laser-induced shock wave may damage the inner ear (17, 18). For the past two years, we have attempted to treat OME by myringotomy with electrotome. We made a hole with a diameter of 4-6mm with electrotome of 20W at the downside of the affected ear drum pars tensa, which can wash the tympanic cavity and clean the accumulated fluid in it (12). The aim of this operation is to create a long-lasting dry eardrum perforation that achieves immediate symptom relief and provides a long-term satisfactory outcome (12).

1 Materials and methods

1.1 Research objects

In this study, 30 subjects (46 ears) were enrolled from patients who were admitted to the first school of clinical medicine of Yangtze university, between January 2017 and April 2019, including 19 males and 11 females, aged 42-68 years, with a course of disease ranging from 2 to 8 years. The case group was diagnosed with nasopharyngeal carcinoma by biopsy and has completed radiotherapy in our hospital. Each participant failed to respond to medication for OME. All patients had experienced myringotomy and myringotomy with ventilation tube at least 3 times. If the tube is removed or falls off, the patient may have a recurrence of OME. Each subject was required to undergo an electronic nasopharyngoscopy examination to eliminate the relapse of NPC.

1.2 Surgical methods

In all 46 ears, electrotome tympanostomy was performed under endoscope. The disposable electrotome of the supporting device is from HongTu medical equipment co. LTD and the tip of the electrotome was protected by a silicagel tube. Endoscope is the XiON Matrix HD3 ultra HD endoscope camera system. The specific surgical procedures were as follows: (a) the ear is routinely sterilized and covered for surgery; (b) after the local skin around the ear is anesthetized with 1% lidocaine, the cerumen and secretions of the external auditory canal are cleaned; (c) the electrotome is used below the ear drum pars tensa to make a hole usually 4-6mm in size when the power is 20W; (d) clean up the accumulated fluid in the tympanic cavity and wash it with dexamethasone, chymotrypsin and saline; (e) check the surgical site to make sure there is no active bleeding. Finally, postoperative patients were treated with antibiotics and mucus-promoting drugs. At the 1st, 2nd and 3rd week after the operation, the patient was reexamined to observe the perforation state of the affected ear. At the 3rd and 6th month after the operation, the perforation state of the ear was observed to understand the long-term effect.

1.3 Efficacy evaluation

Patients with postirradiation otitis media with effusion (OME) are a special group. After the tympanostomy, we expect the hole to shrink but not completely close, so we cannot use the conventional pure tone audiometry and sound conductance

examination to evaluate the curative effect. The main criteria for judging the treatment effect were the EDTQ-7 (19) and the endoscope before surgery and per 3 months after surgery. The criteria for treatment effectiveness are as follows: (a) significantly improved: Eustachian tube function score below 14 with no closed tympanostomy and dryness of the tympanic cavity; (b) mild improvement: eustachian tube function score was 14-35, with no closed tympanostomy and dryness of the tympanic cavity or slightly moist, and there was no purulent secretion; (c) invalid: eustachian tube function score above 35 with no closed tympanostomy, there is purulent secretion in the tympanic cavity or the tympanostomy is closed.

2 Results

2.1 EDTQ-7 score and endoscope review

The EDTQ-7 score of 46 ears before surgery was all above 35 (Table 1). At 3 months after the operation, the EDTQ-7 score of 20 ears was less than 14 points with the no closed tympanostomy, and the tympanic cavity was dry; the score of 18 ears was 14-35 and the tympanic cavity was dry or slightly moist, without purulent secretion; the score of 8 ears above 35, six of them were closed, while two of them were not closed with the purulent secretion of the tympanic cavity (Table 2. Table 4). At 6 months after the operation, the EDTQ-7 score of 21 ears was less than 14 points with the no closed tympanostomy, and the tympanic cavity was dry; the score of 17 ears was 14-35 and the tympanic cavity was dry or slightly moist, without purulent secretion; the score

of 8 ears above 35, six of them were closed, while two of them were not closed with the purulent secretion of the tympanic cavity (Tables 3-5)

Table 1. The patient's preoperative ETDQ

Eustachian tube dysfunction rating scale (ETDQ-7)							
The extent to which the following symptoms have affected you in the past month	Almost no effect		Moderate influence			Serious influence	
Intra-auricular pressure sensation (ear)	0	0	0	0	1	17	28
Intra-auricular pain (ear)	0	0	0	6	4	11	25
Intra-auricular obstruction sensation (ear)	0	0	0	0	1	21	24
Uncomfortable symptoms in the ear (ear) with a cold or rhinitis	0	0	0	0	4	3	39
A cough or a burst bubble sound (ear)	0	0	0	4	7	5	30
Inner ear scream(ear)	0	0	0	1	8	16	21
To be muffled in the ear	0	0	0	0	2	9	35

Table 2. The patient's ETDQ at three months after surgery

Eustachian tube dysfunction rating scale (ETDQ-7)							
The extent to which the following symptoms have affected you in the past month	Almost no effect		Moderate influence			Serious influence	
Intra-auricular pressure sensation (ear)	15	5	8	7	3	3	5
Intra-auricular pain (ear)	9	11	11	2	5	7	1
Intra-auricular obstruction sensation (ear)	14	7	10	1	6	3	5
Uncomfortable symptoms in the ear (ear) with a cold or rhinitis	10	12	5	5	6	4	4
A cough or a burst bubble sound (ear)	17	4	4	5	8	0	8
Inner ear scream(ear)	13	7	1	2	9	8	6
To be muffled in the ear	13	3	5	10	7	2	6

Table 3. The patient's ETDQ at six months after surgery

Eustachian tube dysfunction rating scale (ETDQ-7)							
The extent to which the following symptoms have affected you in the past month	Almost no effect		Moderate influence			Serious influence	

Intra-auricular pressure sensation (ear)	14	6	7	8	4	2	5
Intra-auricular pain (ear)	11	10	10	2	6	5	2
Intra-auricular obstruction sensation (ear)	15	6	11	2	4	4	4
Uncomfortable symptoms in the ear (ear) with a cold or rhinitis	11	11	6	6	4	2	6
A cough or a burst bubble sound (ear)	17	5	2	4	10	2	6
Inner ear scream(ear)	10	10	10	2	2	2	10
To be muffled in the ear	10	5	5	3	15	1	7

Table 4. The postoperative recovery of eardrum

	No closed tympanostomy and dryness of the tympanic cavity or slightly moist	No closed tympanostomy , a little purulent secretion in the tympanic cavity	Completely closed tympanostomy
3 months after surgery (ear)	38	2	6
6 months after surgery (ear)	38	2	6

Table 5. Treatment effect

	Improved significantly	Slightly better	Invalid
3 months after surgery (ear)	20	18	8
6 months after surgery (ear)	21	17	8

3. Discussion

NPC is one of the most common malignant tumors of head and neck in China and radiotherapy is the mainstay treatment for NPC nowadays (20, 21). During radiotherapy, no matter which radiation source is selected, the ear and nasopharyngeal structures are in the radiation field (9). Therefore, while killing the tumor tissues in the nasopharynx, it will also cause catastrophic and irreversible damage

to the normal tissues in the inner ear and nose in this region (9, 11). OME is one of the most troubling auricular side effects and it has been reported that the incidence of OME after ionizing radiation injury can be as high as 70% (7, 22). The pathogenesis of OME may be related to the direct ionizing radiation injury of the middle ear (mainly the eustachian tube) (7) and/or muscle fiber dysfunction (23).

Myringotomy and myringotomy with ventilation tube can improve the ventilation of middle ear (24),

which facilitates the drainage of tympanic fluid and the repair of eustachian tube function. It is an effective method to treat common chronic secretory otitis media (24). Most patients with OME have irreversible damage to the eustachian tube (25), therefore the middle ear effusion will recur after the tube is removed. Moreover, it leads to the high incidence of tympanic sclerosis (26).

In recent years, CO₂ laser tympanostomy has been applied in the treatment of adult secretory otitis media (12). Laser perforation will keep a longer patency than ordinary mucosal knife incision (13). It not only reduces the chance of middle ear infection, but also reduces the possibility of epithelial cells migrating into the tympanic cavity along the incision to form cholesteatoma of the middle ear, which is better than the myringotomy and myringotomy with ventilation tube (13). The perforation of CO₂ laser tympanostomy usually heals in 2-3 weeks, which means the recurrence of symptoms in patients with OME (22).

For the past two years, we have attempted to treat OME by myringostomy with electrotome. We made a hole with a diameter of 4-6mm with the electrotome of 20W at the downside of the affected ear drum tensa. At the same time, we can wash the tympanic cavity and clean the accumulated fluid in it (12). Furthermore, carbonized edges can be formed on the perforation margin (27), which can prolong the required time for the wound on the tympanic membrane to heal, maintaining middle ear ventilation and drainage and promoting recovery of Eustachian tube function (12, 28).

The size of the hole is based on the thickness of the eardrum. The thick eardrum has strong healing ability, so we need to make a diameter of 6mm hole,

which may require 2-3 electrotome cuts. For the thin eardrum, we only need to make a diameter of 4mm hole, which requires a single electrosurgical incision. When electrotome is cutting into the eardrum, the electrode head only need to be placed on the lower surface of the tympanic membrane tensa, and the handle can be pressed lightly on the electrotome mode button for 1 second. This operation will not cause damage to eardrum headland and auditory bone.

After the operation, the myringostomy will gradually become smaller, the ear leakage will occur in some individuals. We will arrange the patients to have a re-examination at the 1st, 2nd and 3rd week after the operation to observe the perforation state. The long-term effect was observed at 3rd and 6th months after the operation. The main means of re-examination was endoscope and EDTQ-7 score was to understand the patient's recovery. For patients with recurrent symptoms and ear leakage, we usually expand the hole, which only requires a 5ml syringe to expand 3 times along the edge of the hole. We use dexamethasone, chymotrypsin and saline to wash the tympanic cavity keep it dry at the long run. Considering radioactive sinusitis and incorrect nose, ear irrigation methods will affect the outcome of our operation, we usually give patients antibiotics and mucus-promoting drugs for 1 months (24). To improve the effect of surgery, we taught the patients to have a correct nasal irrigation especially. Besides, the patients will be followed up for re-examination after surgery. Because a small percentage of patients live outside the city, the re-checking time is not guaranteed. So 1-2 months after the surgery, several patients' holes healed and their symptoms relapsed. Most patients are very satisfied

with the results. The statistical results showed that the clinical symptoms and EDTQ-7 scores of the patients at 3 months were very similar to those at 6 months after surgery. Therefore, we believe that the effect of electrotome myringotomy is stable at 3 months after surgery. Of course, longer re-examination and follow-up time is very meaningful because the re-examination and follow-up time of the tumor is at least 5 years. We hope to have more long-term efficacy observation and large samples to support our study.

4. Conclusions

After two years of clinical practice and observation, we still believe that electrotome is feasible for refractory OME, which can help the patients alleviate symptoms and improve the quality of life effectively.

Declarations

1) Consent to publication

We declare that all authors agreed to publish the manuscript at this journal based on the signed Copyright Transfer Agreement and followed publication ethics.

2) Ethical approval and consent to participants

Not applicable.

3) Disclosure of conflict of interests

We declare that no conflict of interest exists.

4) Funding

None

5) Availability of data and material

We declare that the data supporting the results reported in the article are available in the published article.

6) Authors' Contributions

Authors contributed to this paper with the design (YL), literature search (YL), drafting (YL), revision (YL and YL), editing (YL and YL) and final approval (YL).

7) Acknowledgement

None.

8) Authors' biography

None.

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