

# Compare the management of granular myringitis: carbon dioxide laser and caustic agent cauterization

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## Abstract

**Background and Objectives** Granular myringitis is troublesome for otologist because uncertain etiology and often been overlooked due to vague clinical symptoms and signs. The ideal treatment is elusive. Our study was to investigate the clinical characteristics of granular myringitis and analyzing the effect of the two different strategies, including carbon dioxide laser (CO<sub>2</sub> laser) and caustic agent cauterization to manage granular myringitis. **Study Design:** Retrospective review **Subjects and Methods** One hundred and thirty patients with granular myringitis receiving treatment at a single medical center from July 2009 to January 2018 were enrolled. We retrospectively reviewed the charts and surgical records. The main two different strategies to manage focal refractory granular myringitis were analyzed, including carbon dioxide laser and caustic solution. We also recorded the clinical course and determine which strategy is better. **Results** One hundred and thirty patients with granular myringitis were enrolled. 47/130 (36.1%) had previous otologic procedures. Frequent otorrhea is the most common symptom (66.1%). Posterior-inferior quadrant is the most common site of involvement (58%). The successful rate of CO<sub>2</sub> laser, caustic agent were 94.9% and 79.2%. The recurrence rate was comparable between CO<sub>2</sub> laser and caustic agent. No major complication was found in either individual group. **Conclusion:** Otologic procedure may be a predisposing factor of focal chronic myringitis. Ear drops had poor efficacy compared to other treatments. It can be apply only on minor and fresh symptom cases. In this study, we suggest CO<sub>2</sub> laser can be the first line treatment, especially for the troublesome or refractory GM cases, which had the higher successful rate and less complication comparing to caustic agent cauterization.

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One hundred and thirty patients with granular myringitis were enrolled. 47/130 (36.1%) had previous otologic procedures. Frequent otorrhea is the most common symptom (66.1%). Posterior-inferior quadrant is the most common site of involvement (58%). The successful rate of CO<sub>2</sub> laser, caustic agent were 94.9% and 79.2%. The recurrence rate was comparable between CO<sub>2</sub> laser and caustic agent. No major complication was found in either individual group.

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## Keywords:

Granular myringitis, Myringitis granulosa, Granulomatous myringitis, Granulating myringitis, CO<sub>2</sub> laser, Caustic agent, Otic drops

## Succinct key points

1. GM is a troublesome disease with vague symptoms and hard to eradicate by conservative treatment.
2. Most of the GM cases had previous otologic surgery history, and the most common symptom was otorrhea.
3. Mention to the recurrence of GM, CO<sub>2</sub> laser and causative agents had comparable results.
4. We suggest CO<sub>2</sub> laser can be the first line treatment in refractory GM.
5. Ear drops had poor efficacy compared to other treatments, which should be apply only on minor and fresh symptom cases.

## Introduction

Granular myringitis (GM) is first described by Politzer and Gruber in 1800s as “chronic inflammation of the membrane tympani. It occurs as the result of primary acute myringitis, a sequel of a previous otitis externa or of a perforating inflammation of the middle ear”. It is not an uncommon clinical condition characterized by desquamation of the tympanic membrane and the formation of granulations on the ear drum which may extend to the external auditory canal (EAC). It is thought as an idiopathic inflammatory disease of tympanic membrane and the etiology is still poorly understood. Mohan Bansal had summarized the etiological classification of GM: idiopathic, traumatic, especially after ontological surgery, infection and chronic inflammation, and neoplasm [1]. The presenting symptoms and physical finding can vary over a broad range and sometimes confused with chronic otitis externa or chronic otitis media. Because most symptoms of chronic myringitis are relatively mild and nonspecific, it is often overlooked by clinical practician. However, if left untreated, patients often experience troublesome symptoms and affect quality of life. The treatment of myringitis is diverse, including topical and systemic antimicrobial agents, antiseptic solutions, cauterizing agents, curettage or more aggressive surgical procedures [2]. The ideal treatment is still elusive. Among these, CO<sub>2</sub> laser is a novel option to chronic focal GM. It has the advantages of less invasiveness and more accurate procedures. Though the previous studies had demonstrated the effectiveness of CO<sub>2</sub> laser, there are lack of sample size [3]. We would like to offer a study of 130 patients at a single medical center to investigate two different strategies about managing focal refractory granular myringitis, including carbon dioxide laser and caustic agent solution. Our primary goal is to demonstrate CO<sub>2</sub> laser had a higher successful rate and less complications. We also recorded the clinical course and character of GM in our study.

## Materials and methods

### *Patient population*

Data was retrospectively collected at a single institution from 2009, July to 2018, January. The inclusion

criteria are patients diagnosed of chronic focal myringitis with the symptoms signs for more than one month. We treated those enrolled with ear drop, containing Boric acid, Alcohol and Glycerin Ear Drop (BAAG) otic solution three drops once and three times daily for at least one month. If symptoms persisted or only partial clinical improvement, surgical treatment was implied. The surgery group were divided into the CO<sub>2</sub> laser and caustic agent cauterization with trichloroacetic acid (TAA). The flow chart of data collection was presented in figure. 1. The distribution of CO<sub>2</sub> laser and TAA cauterization were all randomized. Both the CO<sub>2</sub> and TAA group were carried out by a single surgeon under microscope in the operation room, with the record document by the rotated residency at the “Blinded for review”. The excluded criteria were described as below: (1) the patients who had diffused granular myringitis; (2) the disease involve middle ear cavity or external ear canal; (3) accepted surgical treatment differ from CO<sub>2</sub> laser or TAA cauterization; (4) those who had loss followed-up after surgery or refused surgical treatment. We defined the successful criteria as no granulation tissue noted in local finding and symptom improved with post-operative follow up at least four months. If local findings showed granulation tissue again and symptom relapsed within four months to a year after surgery, it will be regarded as recurrence. At last, if symptoms show up again or clinically discover granulation on tympanic membrane after a year after the surgery, we consider it a new onset.

### *Pre-operative survey*

The patient was diagnosed as granular myringitis by otoscope showed eardrum granulation. Patient’s geography data, disease side, involved location were recorded by local finding. The past-history, previous otologic procedure, presenting symptoms, and bacterial culture results were also recorded and analyzed.

Pure tone audiogram (PTA) and tympanogram (Tym) are not routine assessment but a useful tool to help us to access the middle ear status. If patient with more advanced clinical symptoms also received preoperative HRCT scan to exclude other middle ear diseases.

### *Operative settings and surgical techniques*

The CO<sub>2</sub> laser vaporization was performed under local anesthesia in the supine position as for the routine otomicroscopy ear surgeries. Ear speculum was fixed to expose the surgical field. The ear drum was cleaned and then painted with gentian violet to define the extent of epithelium defect. (Figure 2a) Then the gentian violet was cleared by cotton swab. CO<sub>2</sub> laser was used to irradiate the lesion area. The machine of CO<sub>2</sub> laser that we used was Lumenis 30c, setting 2 watts, continuous mode, with spot size of 0.5 mm (Figure 2b). We chose initial lower laser power setting to prevent penetrating injury of the ear drum. Repeat vaporization is allowed to make sure that epithelium layer has been irradiated. The extent of laser spot is same as previous stained area. In practice, one or two additional laser spot is often needed after evaluating the depth of first laser spot (Figure 2c). The TAA cauterization for patients in caustic agent group were also performed under local anesthesia by the same surgeon in supine position as for otomicroscopy ear surgeries. The preparation is same as that in laser group except that TAA (50%) was used to cauterize the epithelium defect. The TAA was applied to the lesion area by cotton tip and remove it after the lesion area was white out. The two strategies are all performed in the operation room.

### *Post-operative follow-up and outcomes*

All patients were regularly followed-up at our outpatient department. The local findings of post-treatment ear drum were evaluated by otoscope. Every patient was followed at our clinic at least four months. The definition of treatment success is no pathologic finding on ear drum and improvement of clinical symptoms four months after the surgery. The definition of recurrence is local finding showing granulation tissue on ear drum again during four months to one year after surgery (Figure 1). Any new complaint or complication were recorded on chart.

### *Statistical analysis*

All the data were expressed as proportions or absolute numbers. SPSS statistical software version 17.0 was used for the statistical analysis. Comparisons of the categorical variables were performed using Chi square test. A p value of less than 0.05 was considered statistical significance.

## Results

Total 130 patients with granular myringitis receiving treatment from July 2009 to January 2018 were enrolled. Patients' age ranged from 11 to 93 year-old (mean age, 58.6). There were 72 male and 58 female, yielding a male to female ratio of 1.24:1. The granular myringitis were unilateral in 128 patients (98.4%) and bilateral in 2 patients (1.6%).

The presenting symptoms of granular myringitis in our 130 cases were shown in table 1. The most common symptom was otorrhea, presented in 86 patients (66.1%). In fact, most patients have two or more non-specific complaints which can be confused with the symptoms of otitis media or otitis externa. Although most symptoms are not life-threatening, but they really bothered the patients' life quality.

Of all the enrollment, 47 patients(36.1%) had received previous otologic surgery on the affected ear, and the category of the surgery was shown in Table 2. The most common physical finding of ear drum on otoscope are a moist area where epithelium layer is absent, often covered with granulation. The most common site of involvement is posterior-inferior quadrant (76/130, 58.5%) (Figure 3). We excluded the extensive disease such as diffused granulation or disease involved to external auditory canal.

The microbiology was analyzed in otorrhea patients, especially purulent discharge. The most common bacteria cultured in our patients is *Staphylococcus aureus*, followed by *Pseudomonas aeruginosa*. [4]

All 130 patients were randomly divided into two groups, CO<sub>2</sub> laser group, and caustic agent with TAA group. They had received eardrops treatment as first for at least 1 month. Only 29 cases (22.3%) had total remission after 1-month treatment, the other failed the treatment due to symptom persist, still granulation found or only partial remission. These patients who failed to ear drop treatment transferred to surgery group and received CO<sub>2</sub> laser vaporization or caustic agents (TAA) cauterization randomly. Excluded those who refused surgery or loss followed up, a total 91 cases received the surgery. 39 cases in CO<sub>2</sub> laser group and 49 cases in TAA caustic agent group. The other 3 cases received other surgical treatment such as conventional cold knife excision or myringoplasty. After four months followed up, 37 cases(94.9%) of CO<sub>2</sub>laser group had successful treatment with no pathologic finding on ear drum and improvement of clinical symptoms. In caustic agent group, only 38 cases (79.2%) had the successful treatment. The CO<sub>2</sub>laser group had significantly higher successful rate than the TAA group ( $\chi^2=5.175$  p=0.023). In recurrence, CO<sub>2</sub>laser group and TAA group had similar results (13.5% vs 18.4%,  $\chi^2 = 0.336$ , p = 0.562). (Table. 3)

The post-operation complication is rare and self-limited. Only one eardrum perforation and one severe vertigo was noted in CO<sub>2</sub> laser group, one hearing impairment in TAA group, but all of them recovered after supportive care. (Table. 3) The pre-operative and post-operative pure tone audiogram (PTA) result showed no obvious influence of hearing function in focal granular myringitis. The most common finding of HRCT showed thickening eardrum and some case showed adhesive drum.

## Discussion

Granular myringitis is a chronic, vascular, fibroproliferative and ulcerative dermatitis which involves focal or diffuse areas of the tympanic membrane. It is a frequently encountered problem in otolaryngologic clinic. The clinical presentation is variable from mild, focal de-epithelization of tympanic membrane to diffuse granular involvement of whole ear drum and external ear canal. If left untreated or unsuccessfully treated, the clinical course may continue for months or years.

The etiology of granular myringitis is numerous, but loss of squamous epithelium on the lateral surface of the tympanic membrane is most accepted mechanism as one of the preliminary stages of granulation development. Mohan Bansal [1] suggested the etiological classification of GM as the Primary granular myringitis (idiopathic) & Secondary granular myringitis. Secondary GM separated into Traumatic, infection and the other neoplastic reasons. Our study stands for this etiological classification, 36.1% of GM patient in our study suffered from previous otologic procedure. We had discovered the location of focal GM mostly occurred at the posterior-inferior quadrant (76/130, 58.5%), which is compatible to the site of tympanic membrane manipulation and elevation of tympanomeatal flap during otological surgery.

There are a variety of treatment regimens available in the management of granular myringitis[2]. To date, no single therapeutic regimen has been determined to be successful in the management of granular myringitis. [5] In our study, we compared the effect of caustic agent cauterization and CO<sub>2</sub> laser vaporization. We had all patients underwent topical otic drops previous to the surgical treatment at least one month, and the total remission rate was only 22.3% (29/130). Most of the patients treated with ear drops exhibited a prolonged recovery period. It often takes few weeks and recurrence occurred as soon as the eardrop therapy was discontinued. In a study conducted by Jung et al [6], majority of patients experienced resolution of their otorrhea within three weeks after dilute vinegar use. We used BAAG solution in majority of patients, and ciprofloxacin ear drops only for patients with purulent otorrhea. Boric acid is a weak acid with antiseptic character which frequently used in antifungal treatment. It can keep the mild acidic environment of external auditory canal. Levinson [7] admitted that there was no effective local treatment which could successfully cure granular myringitis. Cauterization with chemical agent, such as 5-fluorouracil or trichloroacetic acid had been reported by Atef et al [8] with promising results. Cauterization with 50 percent TAA has been trialled for exuberant granulation tissue. In our study, TAA cauterization group successful rate was 79.2% (38/49) and the recurrent rate was 18.4% (7/38). The definition of success was no local finding on ear drum and symptom free in postoperative four months. It seems that both surgical group has higher successful rate and lower recurrent rate compared with simple topical agents. Fechner et al [9] recommended more aggressive treatment for granular myringitis. They used CO<sub>2</sub> laser for refractory myringitis. They suggested that the primary advantage of CO<sub>2</sub> laser over traditional treatment was that the laser not only vaporizes the granulation tissue but also stimulates growth of the surrounding disease epithelium. In our study, the successful rate of CO<sub>2</sub> laser was 94.9% (37/39) and the recurrence rate was 13.5% (5/37). The successful rate was higher than TAA cauterization group which reached statistical significance ( $p < 0.05$ ). However, the recurrence rate was similar to TAA cauterization group ( $p = 0.562, > 0.05$ ). CO<sub>2</sub> laser emits a wave length of 10600 nm and its resurfacing function has been widely used by dermatologist for rhytids and dyschromias. [10] The laser resurfacing technique was used in treating granular myringitis by otologists Cheng et al [10] used CO<sub>2</sub> laser for intractable chronic myringitis. Of 30 affected ears, 22 ears demonstrated total resolution and 7 ears demonstrated partial resolution; disease status remained unchanged in only 1 ear. Jang et al [3] used endoscopy-aided laser therapy for intractable granular myringitis and the CO<sub>2</sub> laser setting was similar to our study. Eighty-five percent (18/21) were cured after single treatment. No adverse effect on hearing thresholds or other complications were observed. They used CO<sub>2</sub> laser equipped with otoendoscopy, providing an unobstructed view, especially at the anterior access. However, it takes more time to set endoscopic equipments. Under microscopy, we can control the surface area and depth of tissue vaporization precisely by varying the laser settings for power, exposure time and spot size. The power can be increased if the operative area is thick. When the given energy level has been applied and the ear drum seems to rupture, the energy level can be lower or the lens adjusted to a defocus setting. El-Seifi and Fouad [11] recommend aggressive surgical treatment approach to granular myringitis as curettage of granulations, elevation of a tympanomeatal flap, cartilage/perichondrium underlay grafting and lateral skin graft coverage of the denuded areas. Recurrence occurred in only 2 of 48 patients. Unfortunately, similar surgical success was not achieved in another smaller series using surgical techniques. [12] 4 of 5 patients developed recurrence. Zhang et al [13] used tympanic epithelial avulsion with overlay myringoplasty to treat 21 severe chronic myringitis cases. All 21 cases were cured after one operation, and no recurrence after two years follow up. Given the variable success of aggressive surgical management of chronic granular myringitis, we suggest the alternative option of CO<sub>2</sub> laser resurfacing treatment for cases refractory to medical treatment. The CO<sub>2</sub> laser is an effective, minimally invasive technique that can be performed safely and easily by an otolaryngologist. The technique provides a viable alternative to more aggressive surgical treatment approaches in patients with granular myringitis refractory to medical treatment.

## Conclusion

Otologic procedure may be a predisposing factor of focal chronic myringitis. Ear drops had poor efficacy compared to other treatments. It can be applied only on minor and fresh symptom cases. In this study, we suggest CO<sub>2</sub> laser can be the first line treatment, especially for the troublesome or refractory GM cases,

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