Effectiveness of 1- and 2- per cent acetic acid solutions in the 2-week treatment of granular myringitis

Mr. Sarun Prakairungthong

A Thesis Submitted in Partial Fulfillment of the Requirements
for the Degree of Master of Science in Health Development
FACULTY OF MEDICINE
Chulalongkorn University
Academic Year 2022

ประสิทธิผลของกรดน้ำส้มสายชูความเข้มข้น 1% และ 2% ในการรักษาภาวะเยื่อแก้วหูอักเสบแบบแกรนูลาร์ในระยะสองสัปดาห์

นายศรัญ ประกายรุ้งทอง

วิทยานิพนธ์นี้เป็นส่วนหนึ่งของการศึกษาตามหลักสูตรปริญญาวิทยาศาสตรมหาบัณฑิต
สาขาวิชาการพัฒนาสุขภาพ ไม่สังกัดภาควิชา/เทียบเท่า
คณะแพทยศาสตร์ จุฬาลงกรณ์มหาวิทยาลัย
ปีการศึกษา 2565

Thesis Title	Effectiveness of 1- and 2- per cent acetic acid solutions in the 2-week treatment of granular myringitis
By	Mr. Sarun Prakairungthong
Field of Study	Health Development
Thesis Advisor	Professor THEWARUG WERAWATGANON, M.D.

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ศรัญ ประกายรุ้งทอง : ประสิทธิผลของกรดน้ำส้มสายชูความเข้มข้น 1% และ 2% ในการรักษาภาวะเยื่อแก้วหูอักเสบแบบแกรนูลาร์ในระยะสองสัปดาห์. (Effectiveness of 1- and 2- per cent acetic acid solutions in the 2-week treatment of granular myringitis) อ.ที่ปรึกษาหลัก : ศ. นพ.เทวารักษ์ วีระวัฒกานนท์

บทนำ: ภาวะเยื่อแก้วหูอักเสบแบบแกรนูลาร์ คือสภาวะที่มีการสูญเสียเยื่อบุผิวที่คลุมเยื่อแก้วหูออกไป ทำให้เกิดอาการหูแฉะ คัน ปวด และมีภาวะแทรกซ้อนเกิดภาวะช่องหูตีบตันได้ โดยในปัจจุบันยังไม่มีแนวทางการรักษามาตรฐาน มีการใช้ยาประกอบการรักษาหลากหลาย และใช้เวลาในการรักษาค่อนข้างนานแตกต่างกันไป

วัตถุประสงค์: เพื่อศึกษาประสิทธิผลของกรดน้ำส้มสายชูความเข้มข้น *1%* และ *2%* ในการรักษาภาวะเยื่อแก้วหูอักเสบแบบแกรนูลาร์ในระยะ *2* สัปดาห์

วัสดุและวิธีการ: การศึกษานี้เป็นการทดลองแบบสุ่มและมีกลุ่มควบคุม เพื่อเปรียบเทียบผลการรักษาผู้ป่วยภาวะเยื่อแก้วหูอักเสบแบบแกรนูลาร์ ระหว่างกลุ่มที่ได้รับกรดน้ำส้มสายชูความเข้มข้น *1%* กับกลุ่มที่ได้รับกรดน้ำส้มสายชูความเข้มข้น *2%* ในช่วงระหว่างเดือน ตุลาคม พ.ศ.2564 ถึงเดือนมิถุนายน พ.ศ. 2565 จากสามโรงพยาบาล ได้แก่ โรงพยาบาลเลิดสิน โรงพยาบาลสมเด็จพระปิ่นเกล้า และโรงพยาบาลศิริราช มีผู้เข้าร่วมการวิจัยทั้งสิ้น 47 ราย ได้รับการสุ่มแบบปกปิดสองทางให้ได้รับยากลุ่มใดกลุ่มหนึ่ง และดูผลการรักษาหาย หรือไม่หายที่ระยะสองสัปดาห์

ผลการศึกษา: อัตราการหายของผู้ป่วยที่ระยะสองสัปดาห์ในทั้งสองกลุ่มมีสัดส่วนที่ไม่ต่างกันอย่างมีนัยสำคัญทางคลินิก และผู้ป่วยทั้งสองกลุ่มสามารถใช้ยาได้โดยไม่พบปัญหารบกวนใด พบอัตราการเกิดเป็นซ้ำในช่วง 8 สัปดาห์ได้ประมาณ 10%

สรุป: ข้อมูลจากการวิจัยไม่พบความแตกต่าง ของน้ำส้มสายชูเจือจาง *1%* และ *2%* ในการรักษาภาวะเยื่อแก้วหูอักเสบแบบแกร์นูลาร์ในระยะ *2* สัปดาห์

สาขาวิชา การพัฒนาสุขภาพ ลายมือชื่อนิสิต .....

ปีการศึกษา 2565 ลายมือชื่อ อ.ที่ปรึกษาหลัก .....

6378006630 : MAJOR HEALTH DEVELOPMENT
KEYWORD: Acetic acid, Granular myringitis, Tympanic membrane, Randomised controlled trial

Sarun Prakairungthong : Effectiveness of 1- and 2- per cent acetic acid solutions in the 2-week treatment of granular myringitis. Advisor: Prof. THEWARUG WERAWATGANON, M.D.

Background: Granular myringitis is characterized by de-epithelization of the tympanic membrane. Patients present with intermittent otorrhea, otalgia or itching. Granular myringitis could result in ear canal stenosis from fibrotic formation if improper or inadequate treatments were offered. At the present, there are still no standard specific topical ear drops for granular myringitis. The choices of treatment are various with inconsistent success rate in variable timeline.

Objectives: To compare granular myringitis treatment between 1% and 2% acetic acid solution at 2 weeks

Materials and methods: This study is a double blind randomized controlled trial to compare the effectiveness of 1% acetic acid solution and 2% acetic acid solution on 2 week-period treatment for granular myringitis. There were 47 participants in this study. They were enrolled and randomly allocated into two groups between October 2021 and June 2022.

Results: The success rates at 2 week-period of treatment between 2 groups were not statistically significant. All patients can tolerate diluted vinegar. Recurrent rate at 8 weeks after completed treatment was 10%.

Conclusions: Data from this study cannot show the difference between 1% and 2% diluted vinegar in granular myringitis treatment within 2 weeks.

Field of Study:	Health Development	Student's Signature .....
Academic Year:	2022	Advisor's Signature .....

ACKNOWLEDGEMENTS

I would like to express my deepest gratitude to my advisor, Professor Thewarug Werawatganon, who guided and encouraged me with my project. I also wish to thank all of my teachers at Thai CERTC consortium for providing me an opportunity to attend this precious program and telling me how to be a better personnel for my university.

I also wish to express my sincere appreciation to the Department of Otorhinolaryngology, Faculty of Medicine, Siriraj Hospital, Mahidol University for affording me the time and funding to participate this course. I also would like to pay my special regards to my chairman of Department of Otorhinolaryngology, Faculty of Medicine, Siriraj Hospital, Associate Professor Phawin Keskool and my colleagues for allowing and supporting me for this course.

I would like to recognize the invaluable co-operative works from my co-authors from Lerdsin and Somdejprapinklao Hospitals ; Dr Thansamorn Chantarawiwat and Dr Lalida Warnpeurch. I also recognize the assistance to Ms.Pataravadee Chukaewrungroj, the pharmacist at Siriraj Hospital for 1% and 2% acetic acid solution preparation in this study.

Finally, I wish to pay my gratitude to all participants of this study. Without their dedication, this study would have not been succeed.

Sarun Prakairungthong

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CHAPTER 1

Introduction

Granular myringitis is characterized by de-epithelization of the tympanic membrane. Generally, granular myringitis can be missed when clinicians use only general otoscopic examination. General practitioners frequently misdiagnose of granular myringitis as otitis externa or suppurative otitis media[1]. The most common presentation of granular myringitis is intermittent otorrhea[2]. However, otalgia, itching or incidental finding can be the presenting symptoms[3]. Tympanic membrane perforation can also be found concurrently in some cases of granular myringitis[4]. Granular myringitis could results in ear canal stenosis from fibrotic formation due to improper or inadequate treatments.

At the present, there is still no standardized specific treatment[5-8] for granular myringitis. The choices of treatment are various with inconsistent success rate such as antibiotic ear drops, diluted vinegar solution, diluted hydrogen peroxide, Castellani solution and Laser.

The duration of treatment usually was determined from several weeks to months period. A long-standing period of granular myringitis treatment may cause many collateral effects such as higher expense or lower compliance to drug use. In the other way, a long period usage of antibiotic or antibiotic combined with steroid ear drops may provoke negative effects either induction of drug resistance or induction of opportunistic fungal infection.

Diluted vinegar solution (a kind of antiseptic solution) is an interesting option for granular myringitis treatment. Topical acetic acid was used as acidic astringents for century[9]. They were frequently applied to treat mild to moderate cases of otitis externa until antibiotic era. There are evidences either in vitro or in vivo about antimicrobial effect of acetic acid[10-12]. Nevertheless, the proper concentration of diluted vinegar on granular myringitis treatment is still in question. In higher concentration with lower

pH, the solution might increase antimicrobial effect while local irritation might be more severe as well.

This study is aimed to assess the effectiveness of higher concentration of acetic acid solution while monitoring the local irritative effect to the patient.

CHAPTER 2

REVIEW OF RELATED LITERATURES

During 1998 to 2000, Wolf et al[4]. observed 26 granular myringitis patients. The authors characterized granular myringitis into 4 grades. The patients would be categorized into grade I when there was only focal de-epithelization of tympanic membrane.

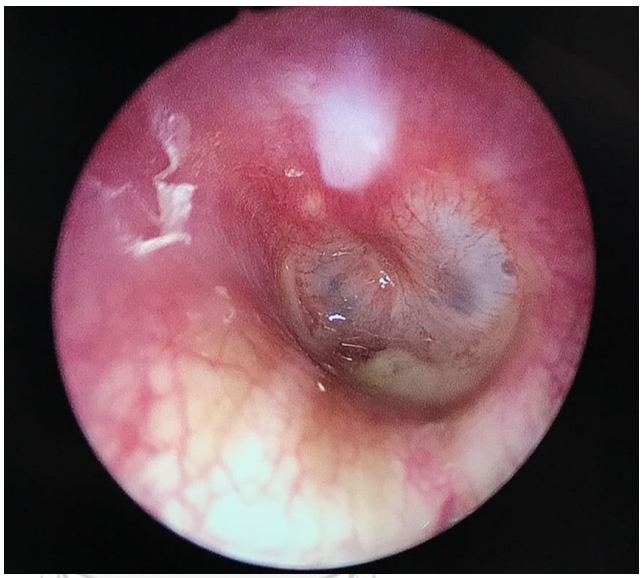


Figure 1. Grade I granular myringitis

The patients would be categorized into grade II when there was a focal raised polypoid formation of tympanic membrane. While grade III would be documented if there was diffuse involvement of tympanic membrane. Lastly, if the polypoid formation involved part of the ear canal the patients would be classified into grade IV.

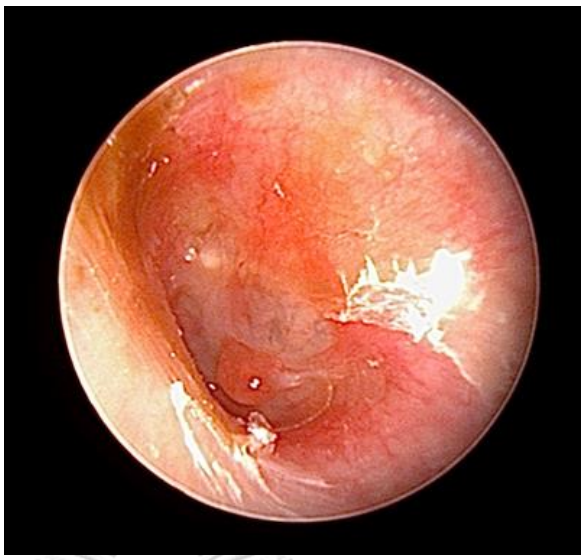


Figure 2. Grade II granular myringitis

The topical eardrops used in this study were either antibiotic or antibiotic plus steroid eardrops. The authors gave topical 80% phenol solution for unresponsive cases. They reported that all patients recovered within 9 weeks with this protocol.

In 2000, El-Seifi and Fouad[13] described their evolution of granular myringitis management. They had used topical antibiotic plus steroid eardrops with occasional cauterization at the initial and the result was not good enough. Later they developed complex regimen including 1.5% acetic acid solution, antibiotic steroid eardrops and steroid fungicidal cream for treating granular myringitis. They claimed the excellent results at 10 days.

In 2002, Jung et al[14] reported their success in treatment of granular myringitis. They performed retrospective study from 1962 to 1996. In the early period, the author gave 15 granular myringitis patients ofloxacin eardrops twice to four times a day and in the later period, their regimen was switched to 1.25% acetic acid solution irrigation once or twice a day. The antibiotic group showed 33.3% success rate at 2 weeks while diluted vinegar irrigation group had 93.3% success rate at the same duration. Granular myringitis patients with any degree of tympanic membrane perforation were excluded from this retrospective study.

In 2010, Taneja[15] used antibiotic eardrops, antifungal eardrops, 2% vinegar in saline solution and 2% vinegar in alcohol for otitis externa and myringitis. The author collected 1686 out patients and there were 1234 patients completed this study. The author did not clarify definitions of inclusion criteria for myringitis patients and also excluded patients with tympanic membrane perforation. Focusing only on myringitis subjects, success rates of antibiotic and antifungal group, 2% vinegar in saline, 2% vinegar in alcohol were 67%, 81.03% and 0 % consecutively. Nevertheless, the author said all patients tolerated the vinegar reasonably.

Bansal M[16] did extensive review about granular myringitis in 2017. The author's interests were etiologies, predisposing conditions, pathological findings, clinical examination features and associated disorders. There were 68 publications included in the study. The author classified the causes of granular myringitis into primary which is idiopathic and secondary which is as a result of trauma and infection. The author stated that many studies revealed positive bacterial culture from aural discharge such as Staphylococcus, Corynebacterium and Pseudomonas aeruginosa.

Thorp et al[12] were interested about antibacterial activity of acetic acid solution and Burow' s solution against *Pseudomonas aeruginosa, Staphylococcus aureus, Proteus mirabilis* and *Streptococcus pyogenes.* They plated organisms onto blood agar. After that, they observed the effect of 1%, 2% and 3% of acetic acid solution and Burow's solution against the bacterial growth. The authors concluded 2% , 3% acetic acid solution and Burow's solution were active against the organisms.

A randomized controlled trial[3] on granular myringitis treatment was conducted in 2020. The authors compared between chloramphenicol eardrops and 1% acetic acid solution. The authors measured the outcome at 8 weeks. The success rate of diluted vinegar and chloramphenicol groups were 91.7% and 66.7% consecutively. There is no statistically significant difference between these success rates. However diluted vinegar group tended to heal completely earlier. When looking the success rate at 2 weeks period, diluted vinegar group showed recovery rate around 40%.

As mentioned above, It seems likely that diluted vinegar has more advantage in granular myringitis treatment over antibiotic or antibiotic plus steroid ear drops. Furthermore, the variant of vinegar concentration cannot be concluded that which concentration is the most suitable for granular myringitis treatment in term of success rate or side effects.

CHAPTER 3

RESEARCH METHODOLOGY

Research question

Does 2% acetic acid solution bring out different effect from 1% acetic acid solution on granular myringitis treatment at 2 weeks?

Objective

To compare granular myringitis treatment between 1% and 2% acetic acid solution at 2 weeks, and to assess the chance of recurrence

Hypothesis

Null hypothesis: There is no difference in success rate of granular myringitis treatment at 2 weeks between 1% and 2% acetic acid solution.

Alternative hypothesis: There is a difference in success rate of granular myringitis treatment at 2 weeks between 1% and 2% acetic acid solution.

Conceptual framework

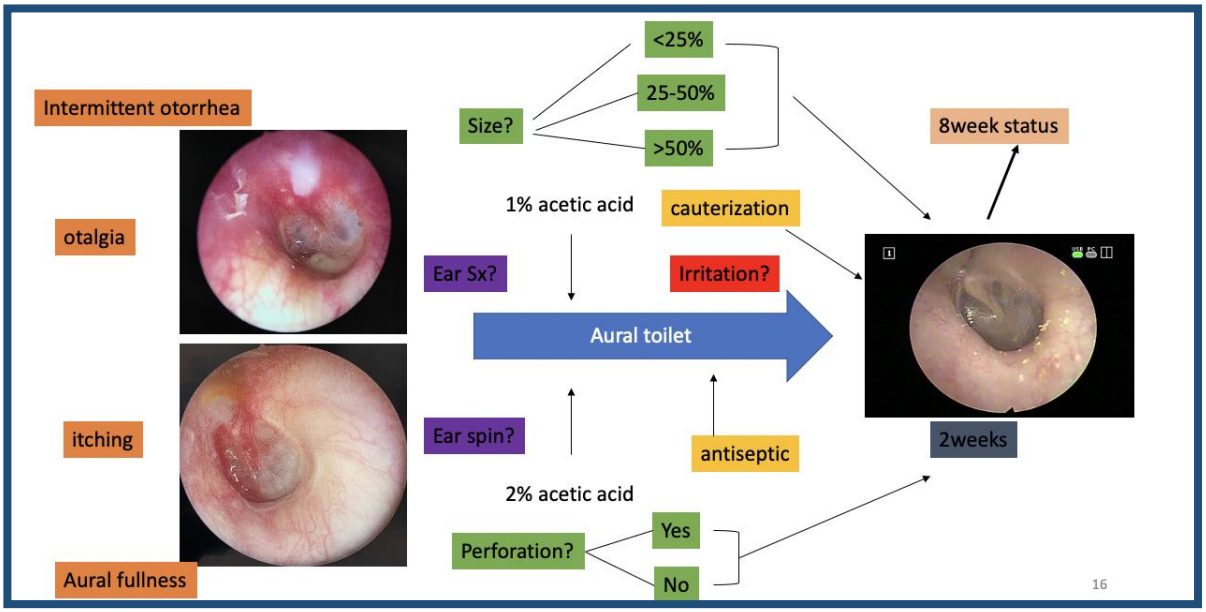


Figure 3. Conceptual framework of the study

Keywords

Acetic acid, Granular myringitis, Tympanic membrane, Randomized controlled trial

Operational definitions

Diagnosis

Either endoscopic examination or microscopic examination

De-epithelized tympanic membrane without active middle ear disease

Adjuvant therapy

Aural toilet clinicians will clean ear canal meticulously by proper instruments and suctioning.

Chemical cauterization by trichloracetic acid, astringent products such as merbromin solution may be applied

Success

Complete epithelization of tympanic membrane

Evaluated either with endoscopy or microscopy

Research design

A comparative randomized double blind controlled trial study

Population and sample

Study population

Patients with granular myringitis who visited to Lerdsin Hospital, Somdejprapinklao Hospital and Siriraj Hospital

Non-probability sampling

Convenience sampling, consecutive cases method

Sample of this study

Patients with granular myringitis who meet the eligible criteria at Siriraj hospital, Lerdsin Hospital and Somdejprapinklao Hospital after certificates of approval from each institutional review board were accomplished.

Inclusion criteria

Granular myringitis patients grade I and II who are 18 years old and above

- grade I : granular myringitis patients with only focal de-epithelialization
- grade II : granular myringitis patients with focal raised polypoid formation

Exclusion criteria

- tympanic membrane perforate more than 3 millimeters in diameter
- history of intolerance to acetic acid
- prior ear operation on that side within 3 months
- concomitant middle ear disease

Withdrawal or termination criteria

- Severe irritation to acetic acid solution

Sample size calculation

Sample size calculation for testing difference of 2 independent proportions

Reference Fleiss JL, Levin B, Paik MC. Statistical Methods for Rates and Proportions. 3rd edition. New York:John Wiley & Sons;2003.

$$N = \left[\frac{Z_{\alpha/2}\sqrt{2P(1-P)}+Z_{\beta}\sqrt{P_1(1-P_1)+P_2(1-P_2)}}{P_1-P_2}\right]^2$$

Reference proportion from studies of Prakairungthong S[3] and Taneja MK[15]

Success rate of 2% acetic acid at 2 weeks P_1 = 0.81

Success rate of 1% acetic acid at 2 weeks P_2 = 0.40

$P = (P_1+P_2)/2 = (0.81+0.40)/2 = 0.605$

At test significant level α = 0.05 and β = 0.2

$Z_{0.025}=1.96$, $Z_{0.2}=0.84$

Thus n per group = 22

This study requires sample size of 44 participants with equal ratio between two groups. Expected drop-out rate 10% is included. Therefore, the study requires total of 48 participants (24 participants for 1% acetic acid solution group and 24 participants of 2% acetic acid solution group).

Research methodology

1. **Protocol registration**

   After the study has been approved by 4 institutional review boards, the

protocol will be registered to Thai Clinical Trials Registry (http://www.clinicaltrials.in.th)

2. **Screening process**

   After the study protocol is approved from 4 institutional review boards,

Siriraj Hospital, Lerdsin Hospital, Somdejprapinklao Hospital and Chulalongkorn memorial Hospital. All Siriraj ENT staffs and residents including otologists at affiliated hospital are informed about the study protocol. Suspected patients would be confirmed diagnosis of granular myringitis by either microscopic or endoscopic examination.

3. **Enrollment process**

   The patients who meet the eligible criteria are informed about the protocol, risks, benefits and possible adverse events from the study by research assistants to avoid undue influence from attending physicians.

Patients obtain participant information sheet and consent form and freely to ask for further information about the study. Patients who decide to participate the study have to sign their signatures in the participant information sheet and consent form.

4. Randomization process

Fourty-eight bottles of medication, 24 bottles of 1% diluted vinegar (1 cc of

acetic acid combined with 99 cc of sterile water) and 24 bottles of 2% diluted vinegar (2 cc of acetic acid combined with 98 cc of sterile water), were prepared and randomly be numbered from 1 to 48. The randomization in this study was processed via www. randomization. com organized by the pharmacists who prepared them. Except for the number randomly assigned to each bottle, all other characteristics would be exactly the same. The researchers were blinded to the study drug assignment for each patient, and this information would be only known to the pharmacists. Random sampling and allocation concealment for reducing bias were fully allowed in this study.

Figure 4. example of running number bottle

5. Research Protocol

Diagnosis of granular myringitis was based on clinical examination using microscopic or endoscopic examination with electronic photograph recording. Diagnosis and outcome measurement were confirmed by experienced otologist and patients who met the criteria would be recruited into the study. Tympanic membrane status in question would be recorded for consensus.

Co-intervention as local wound care would be performed on case-by-case basis, such as ear toilet, cauterization with 85% trichloroacetic acid or application of 2% merbromin solution, were applied as needed at each visit as a standard procedure for local wound care management.

Patients 1-8 were enrolled at Lerdsin Hospital, patients 9-32 were enrolled at Siriraj Hospital and patients 33-48 were enrolled at Somdejprapinklao Hospital. Appointment 1 to 2 weeks was arranged. Monitoring book would be recorded by patients during treatment period.

After 2 weeks, unhealed granular myringitis participants would be treated continuously until recovered tympanic membranes were identified.

Figure 5. caustic agent

Figure 6. astringent product

6. Drug information

Vinegar is an inexpensive organic product that is widely available worldwide. It is derived from sugar and starch fermentation that initially produces ethanol, but subsequently produces acetic acid. In addition to its use as a food, vinegar is also used for medical purposes. It has antimicrobial properties to destroy both bacteria and fungus, such as Pseudomonas aeruginosa[10], Staphylococcus aureus, Klebsiella, Acinetobacter, Escherichia coli, Methicillin-resistant Staphylococcus aureus, Proteus mirabilis, Candida albicans, Aspergillus niger, and Aspergillus fumigatus[11]. The mechanisms of the antimicrobial properties of vinegar include inhibition of the growth of bacteria and fungus by creating an acidic environment, reduction of bacterial protease activity, and promotion of wound healing.

The pharmacist at Siriraj Hospital prepared 1% acetic acid solution (1 cc

of acetic acid combined with 99 cc of sterile water) and 2% acetic acid solution (2 cc of acetic acid combined with 98 cc of sterile water) for this study.

Patients would be advised thoroughly to use their assigned topical eardrops 4-6 drops for 3 to 5 minutes, 3 times a day. Each patient had a follow-up appointment within 7-14 days. The outcome would be measured between 14-20 days.

7. Outcome measurement

Demographic data

- Age, gender
- Comorbidities
- Side of lesion, duration and presenting symptoms
- Size, grade and perforation of tympanic membrane
- History of ear surgery

Primary outcome

- Complete epithelization of tympanic membranes observed at 2 weeks period would be documented as RECOVERED
- The rest would be documented as NOT RECOVERED

Secondary outcome

- Burning sensation would be recorded from each visit as NO, FAIR or SEVERE

Long term outcome

- Tympanic membrane status during 6 to 8 weeks might be monitored and defined as NOT HEAL, HEALED, RECURRENT

Statistical analysis and data imputation

The data were analyzed as intention-to-treat protocol. In case of patients withdrawal or any loss follow up, data imputation would be done as worst case scenario in both groups. The results at 2 weeks would be recorded as NOT RECOVERED. However the data would be analyzed in per protocol fashion concomitantly for overall aspects.

Descriptive analysis for baseline characteristics would be presented as percentage (%), mean ± standard deviation, or median with interquartile range, as appropriate.

Comparison of the results between 1% and 2% acetic acid solution at 2 weeks and categorical data such as gender, history of ear surgery, grading and size of disease would be performed using chi-square or Mann-Whitney test. A p-value of less than 0.05 would be considered statistically significant. All data were analyzed using SPSS Statistics version 26 (SPSS, Inc., Chicago, IL, USA).

Ethical considerations

Respect for persons

All participants were clearly informed about the protocol, risks and benefits of the research. Any queries about the research would be willingly answered by the researchers. This process occured since the patients were diagnosed as granular myringitis. The patients will have time to consider about research participation. If they are interested to participate the research, participants have to sign their voluntary participation in the

provided consent form and participant information sheet. Participants who are not interested to attend the research would be treated as usual standard of care.

Beneficence

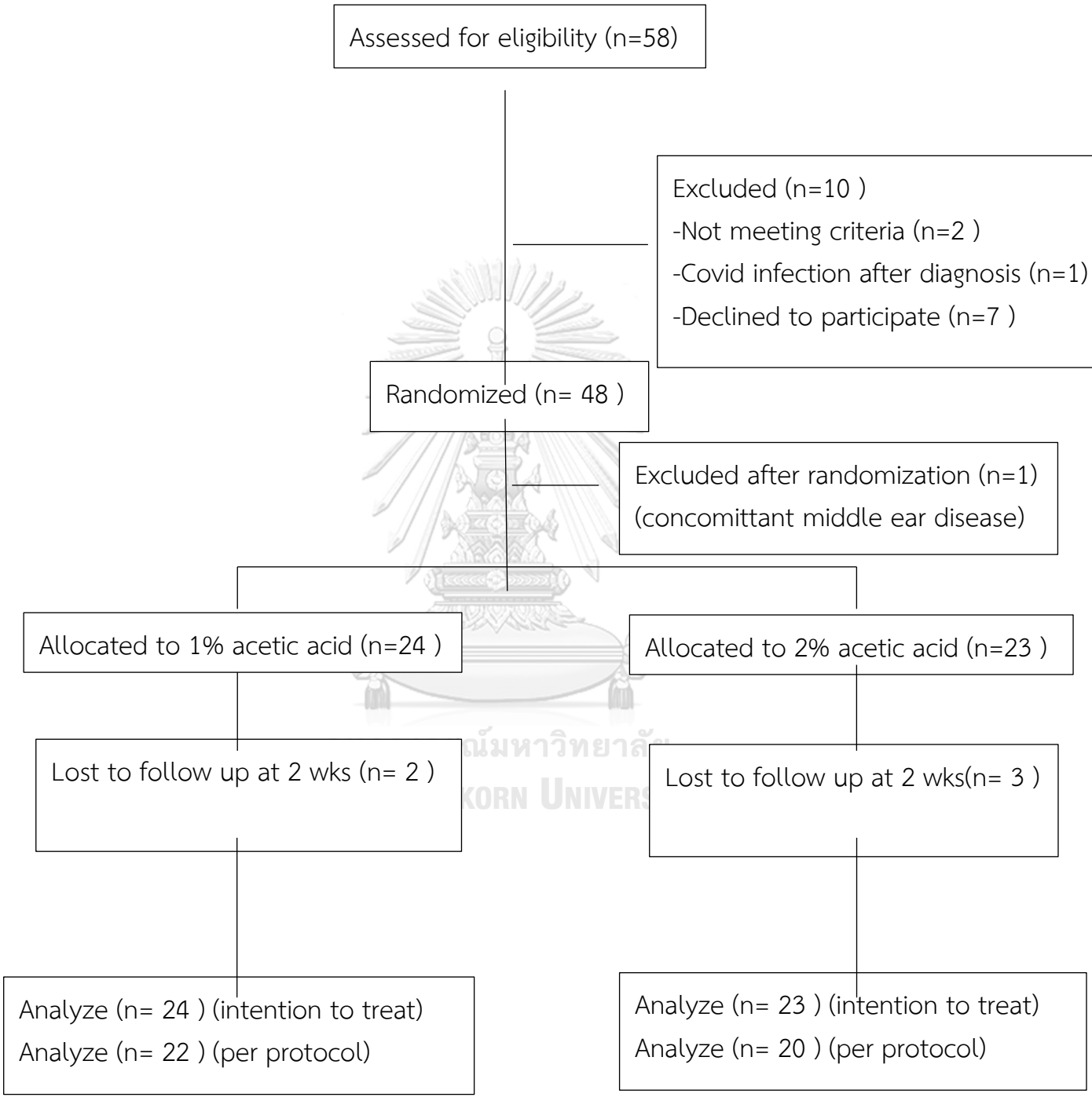
All risks and benefits of the research had been explicitly reviewed by the researchers. Comparison group was treated with standard care for granular myringitis as standard practice. Acetic acid was derived from organic substance. Participants had very low risk from exposure to acetic acid.

Justice

All eligible patients were equally informed about the research and consecutively selected to participate the research. The participants were allocated into one of treatment arms by randomization process with concealment of treatment group to the outcome assessors.

CHAPTER 4

RESULTS



Flow chart 1

There were 58 patients asked to participate in this study. Two patients were not included due to their age and disease severity did not

meet the inclusion criteria. One patient was diagnosed COVID-19 infection at the same time and seven patients declined to participate the study.

Totally, there were 48 patients included and randomized into 2 groups. There were 4 participants who had bilateral myringitis and we chose only one side sequentially from right to left.

After enrollment to the study, one more patient was excluded from the study. The patient had been confirmed having active middle ear disease and tympanomastoidectomy was finally performed.

These 47 participants were enrolled from 3 hospitals in Bangkok metropolitan. 24 patients were categorized into 1% acetic acid solution group and 23 patients were in 2% acetic acid solution group. The mean age between 2 groups were not different. Other than history of ear surgery, another demographic data between 2 groups were not different. All demographic data can be reviewed in the Table 1.

Demographic data	Servicing centers			Total (n=47)	1%Acetic Group (n=24)	2%Acetic Group (n=23)
	Siriraj (n= 23)	Lerdsin (n= 8)	SPPH* (n= 16)			
Age (years), mean±SD	56+-12	54+-7	56+-14	56+-12	56+-13	55+-11
Female gender (%)	73.9%	75%	50%	66%	58.3%	73.9%
Right side (%)	39.1%	50%	31.2%	38.3%	37.5%	39.1%
Had ear surgery before (%)	43.4%	12.5%	0%	23.4%	12.5%	34.8%
Had perforation (%)	21.7%	0%	6.2%	12.7	12.5%	13%
Duration (days), median (IQR)	30	43	7	30(7,56)	29(7,52)	30(7,56)
Grading - Grade I - Grade II	 12 11	 0 8	 5 11	 17 30	 8(33%) 16(67%)	 9(39%) 14(61%)
Size of myringitis (%) -Not more than quadrant -25-50% -More than 50%	 8 13 2	 1 7 0	 3 10 3	 12 30 5	 7(29%) 16(67%) 1(4%)	 5(22%) 14(61%) 4(17%)

Table 1 Demographic data

(*Somdejprapinklao Hospital)

In our granular myringitis population, female and left side were predominant. Around 13% of the patients had tympanic membrane perforation as a co-presenting symptom of the disease. More than half of patients had no history of ear surgery. Median of duration of symptoms before seeking for clinician were about a month. The most common presenting symptoms were otorrhea and itching. (Table 2)

Clinical presentation	1% acetic group (N=24)	2% acetic group (N=23)	Overall (N=47)
Otorrhea	17(70.8%)	19(82.6%)	36(76.6%)
Itching	15(62.5%)	14(60.9%)	29(61.7%)
Aural fullness	9(37.5%)	4(17.4%)	13(27.7%)
Otalgia	5(20.8%)	2(8.7%)	7(14.9%)
History of habitual ear picking	14(58.3%)	15(65.2%)	29(61.7%)

Table 2 Presenting symptoms

Three participants (13%) lost to follow up at 2 weeks period from 2% acetic acid solution group while 2 participants (8%) lost to follow up from 1% acetic acid solution group. From remaining participants, one participant from 2% acetic acid group reported unsatisfied with ear drop. Six participants (4 from 1% group, 2 from 2% group) reported some irritation with ear drop. However these participants had no difficulty finishing the study.

Within 2 weeks period of the study, there were 125 visits to be recorded. Patients were received cauterization 64/125(51.2%) and were applied with 2% merbromin solution 66/125(52.8%). These co-interventions were performed equally in both groups.

The success rate at 2 weeks from 1% and 2% acetic acid solution with data imputation for missing data cases were 70.8% and 52.2% consecutively which were not different statistically. In term of 1% acetic acid protocol, treatment can achieve 70.8% success rate at 2 weeks period, 79% success rate at 4 weeks period and 83.3% success rate at 6 weeks period. In 2% acetic acid solution group which topical ear drops were

switched after 2 weeks, success rate at 4 and 6 weeks were 56.5% and 73.9% consecutively.

If we remove the data of 5 lost follow up patients and calculate only the full follow up data with per protocol. The success rate of 1% and 2% acetic acid solution would be 77.3% and 60% consecutively. The difference of success rate between 2 groups were not significant from both intention to treat and per protocol calculation. The number of cured patients in 1% acetic acid solution group was slightly superior to 2% acetic acid solution group but not reached the statistical significance. (Table 3)

Outcomes	Servicing centers									
	Siriraj		Lerdsin		SPPH*		Total			
	1%	2%	1%	2%	1%	2%	1%	2%	*P* value	Prop. Diff** (95% CI)
Success rate at 2 weeks (%) With data imputation										
-NOT RECOVERED	3	6	2	2	2	3	7 (29.2%)	11 (47.8%)	0.094	
-RECOVERED	9	5	2	2	6	5	17 (70.8%)	12 (52.2%)		0.19 (-0.09-0.44)
Analyze for per protocol										
-NOT RECOVERED	2	5	2	1	1	2	5 (22.7%)	8 (40%)	0.113	
- RECOVERED	9	5	2	2	6	5	17 (77.3%)	12 (60%)		0.17 (-0.11-0.42)

Table 3 Results of success rate at 2 weeks

(*SPPH – Somdejprapinklao Hospital),(**Prop.Diff.-Proportion Difference)

There were 11 participants who had history of ear surgery in the past. Success rate at 2 weeks of these participants were 72.7% (8 of 11). While the success rate of 36 participants who had no history of ear surgery were 58.3% (21 of 36)

From 29 participants who had cured within 2 week-period treatment of 1% and 2% acetic acid, there were 3 out of 29 cured participants (10.3%) having evidence of recurrence of disease within 8 weeks follow up. In contrast, there were 13 patients in per-protocol analysis who failed the treatment at 2 weeks with 1% and 2% acetic acid. These patients still were taken care further by proper standard ear care and home eardrops. Some were prescribed with the remaining same medication while some were prescribed with alternate medication such as clotrimazole eardrops. Last patient from 1% acetic acid group could achieve healed myringitis at 16th week while patients from 2% acetic group still needed longer period of treatment. (Figure 7)

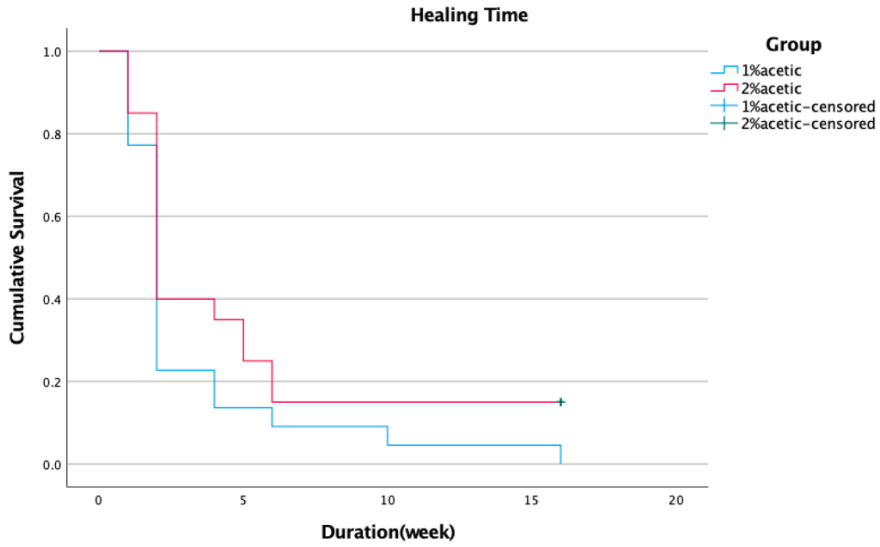


Figure 7 Kaplan-Meier overall outcome from each arm

CHAPTER 5
DISCUSSION

In our previous study[3], we found 1% acetic acid solution can treat granular myringitis effectively comparing to antibiotic eardrops. Nevertheless, we wondered there are any regimens could shrink the duration of treatment or not. Although granular myringitis might be affected from infection[2], the higher percentage of dilute vinegar which has more potent antibacterial property[10, 12] may give us more effective result.

Apparently, there was no statistical significance between 1% and 2% acetic acid solution treatment for granular myringitis in this study. The success rate of 1% acetic acid group seems likely to be superior to 2% acetic acid group in raw data. Both groups reported regular medication use as prescribed. Though participants from 2% acetic acid group which the ear drop was more strength in lowering pH in the ear canal was expected to have more irritation symptoms, the patients still had a good compliance.

There were no significant differences between the demographic data of the 2 groups. Nevertheless, the groups had a significant difference in their history of prior ear surgery (p=0.04). The 2% acetic acid solution group had 3 times higher percentage than 1% acetic acid solution group (34.8% and 12.5%). Either tympanoplasty or myringotomy was performed on the lesion side. It may be that these operated ears had some residual degree of impaired middle ear function. Middle ear dysfunction may be a confounding factor in the healing process of granular myringitis. However, when we considered cure rate at 2 weeks between patients with and without prior ear surgery, there were no significant difference in percentage of cure rate (p=0.492).

These 2 groups used the same protocol to manage the patients' problems. First step was aural toilet which is not only for ensure diagnosis but also enhance the resolution of disease. Next steps they were applied a

chemical cauterization or astringent product which were performed depending on characters and severity of the granular myringitis. The difference between two groups were abilities of medications to produce pH condition in the ear canal and antimicrobial activity. The comparable result in this study imply that eardrops might be only complimentary process for granular myringitis treatment.

Consideration of granular myringitis management globally[17], the resolution rate was inconsistency from study to study. Unsurprisingly, the cut off timing for reporting cured rate were not clear. Those reports varied from several weeks follow up to several months follow up. As we know, there is no effective modalities. We did the systematic literature searching about myringitis treatment revealed various treatment options, which were CO_2 laser, surgery and various kinds of otic drops. Generally, otic drops of choice of physicians were various such as antibiotic drops, antibiotic plus steroid drops, diluted vinegar. The purposes of eardrops prescribing depend on possibility of causes. Physicians who believe in infection process may prescribe for antimicrobial activity while physician who believe in inflammatory process may prescribe steroid drops for anti-inflammatory activity.

Actually main primary treatment procedure for granular myringitis should be local wound. The affected moist ear, coating discharge and debris need to be cleaned meticulous completely. Remaining debris or sticky coating discharge can cause further epithelial maceration. In addition, chemical cauterization and astringent products enhance the period of dryness which urge epithelial migration to heal the myringitis. Eardrops during follow up period are prescribed from attending physicians for local ear care purpose. Follow up period should not be longer than 1 week. As unhealed granular myringitis still have more discharge and debris occurrences, these depositions can delay healing. The patients who fail to these non-invasive management should be switch to surgical management.

Factors that may affect the healing rate is severity of disease. In this study, we graded our participants follow to Wolf et al[4]. Grade II was considered more severe as focal raised polypoid formation occur. We found that grade II tend to heal incompletely and slower duration rate.(Figure 8)

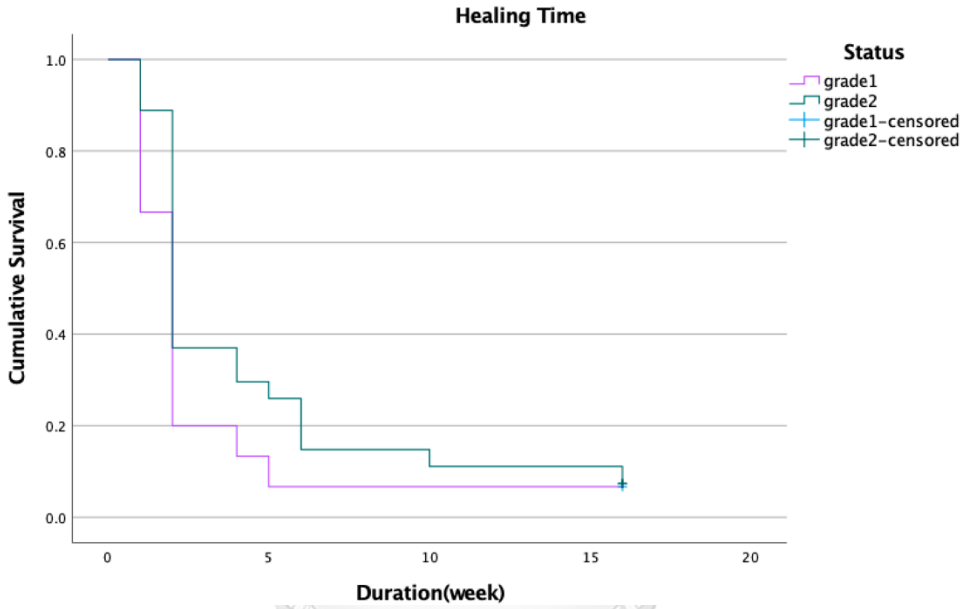


Figure 8 Kaplan-Meier overall outcome from each grade

We also considered tympanic membrane perforation at a presenting finding as a poor prognosis factor. In that study[3], we had tympanic membrane perforation cases at 33% and the success rate at 2 weeks of 1% acetic acid group was around 40%. In this present study, we had tympanic membrane perforation cases at 13% and the success rate at 2 weeks of overall was 61.7% . The difference of success rate of these 2 different population might support our idea about poor prognosis factor of tympanic membrane perforation at presenting symptom. Focusing on the result of this study, there were more unhealed cases in patients with tympanic membrane perforation. (Figure 9)

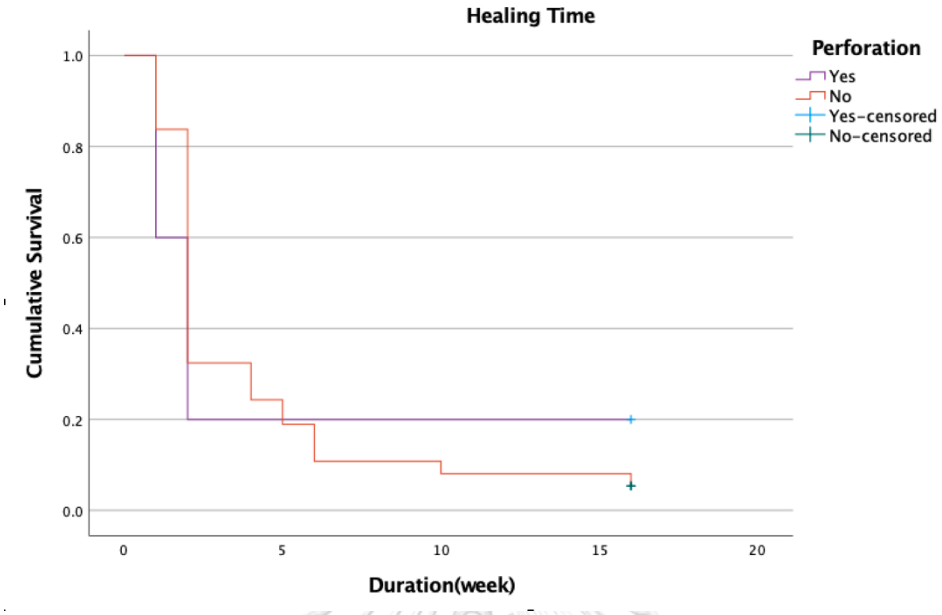


Figure 9 Kaplan-Meier overall outcome from tympanic membrane perforation or not

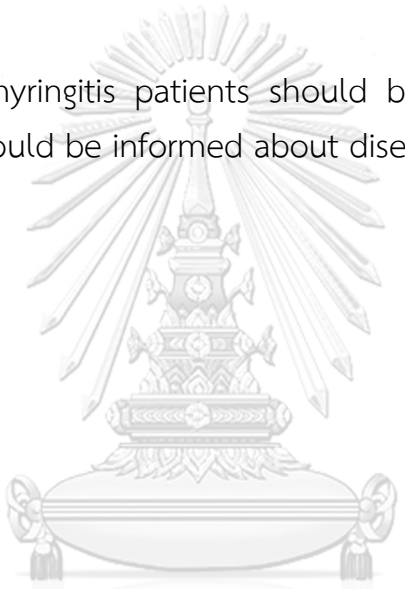
Another point of concern is recurrence of disease. There were 3 out of 29 cases from cured group that had recurrence within 8 weeks. Two cases were from 1% acetic group and another one was from 2% acetic group. Those 3 cases were about 10% recurrent rate. There was something in common from those of 3 cases. They did not frequent have habitual ear picking. Two of them never use the cotton bud and the rest use cotton bud sometime. These might imply that the etiologies of their granular myringitis are uncleared and not expected from trauma. This increases the chance of recurrence because the patients did not know how to prevent or avoid the disease recurrence.

CHAPTER 6

CONCLUSION AND RECOMMENDATION

We cannot prove the difference between 1% and 2% acetic acid solutions in granular myringitis treatment within 2 weeks. Either 1% or 2% acetic acid solutions promoted healing of granular myringitis within 2 weeks satisfactorily. Local wound care procedures are also necessary either toilet for cleaning or chemical cauterization and astringent product application for dryness.

All granular myringitis patients should be followed up in 1 week period. They also should be informed about disease recurrence.



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APPENDICES

Appendix 1 Case record form

Case record form

Effectiveness of 1% and 2% acetic acid solution on 2 weeks-period treatment for granular myringitis

Patient study number.....

Duration of symptoms..... Age at diagnosis.....years

Sex ☐ 1. Male ☐ 2. Female

Side ☐ 1. Left ☐ 2. Right ☐ 3. Bilateral

Symptoms ☐ otorrhea ☐ otalgia

☐ itching ☐ ear fullness ☐ .....

History of ear spin ☐ no ☐ sometime.

☐ nearly everyday ☐ everyday

History of ear Sx ☐ No ☐ Yes

If Yes, which kind of ear surgery

☐ myringotomy ☐ myringoplasty

☐ .....

Which side ☐ 1. Left ☐ 2. Right ☐ 3. Bilateral

When it was done last _____ /_____ / _____ (DD/MM/YYYY)

Bottle No	Grade	Size	Perforation	Ear irritation	Adjuvant
Date of Diagnosis	☐ I	☐ <25%	☐ no		☐ aural toilet

...../...../.....	☐ II	☐ 25-50% ☐ >50%	☐ pinpoint ☐ 1-3mm		☐ cauterization ☐ Merbromin ☐ Gentian violet
1st Follow up		☐ <25% ☐ 25-50% ☐ >50% ☐ cured	☐ no ☐ pinpoint ☐ 1-3mm	☐ no ☐ fair ☐ severe	☐ aural toilet ☐ cauterization ☐ Merbromin ☐ Gentian violet
2 weeks period		☐ <25% ☐ 25-50% ☐ >50% ☐ cured	☐ no ☐ pinpoint ☐ 1-3mm	☐ no ☐ fair ☐ severe	☐ aural toilet ☐ cauterization ☐ Merbromin ☐ Gentian violet

Management after study

.....

.....

.....

Complete healing date ...../...../.....

6th- 8th week status ☐ not heal ☐ healed ☐ recurrent

Did patient satisfy their acetic acid solution ☐ No ☐ Fair ☐ Yes

Did patient satisfy 2 weeks treatment period. ☐ too long ☐ OK

Did patient can tolerate cauterization ☐ No ☐ Fair ☐ Yes

Did patient can tolerate merbromin scrub ☐ No ☐ Fair ☐ Yes

Investigator signature.....

Date ...../...../.....

ตารางการหยอดยารักษา เยื่อแก้วหูอักเสบแกรนูลาร์

วันที่หยอด (วว/ดด/	เช้า (x)	กลางวัน (x)	เย็น	อาการปวด แสบ ระคาย (มาก น้อย

ปปปป)			(x)	ไม่มี)
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วันเริ่มหยอดยา

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วันหยุดหยอดยา

.....

Appendix 2 Ethical approval Siriraj

2 WANGLANG Rd. BANGKOKNOI
BANGKOK 10700

Tel. +66 2419 7000-72
Fax. +66 2411 0162

Siriraj Institutional Review Board

Certificate of Approval

COA no. SI 208/2021

Protocol Title(English)	:	Effectiveness of 1% and 2% acetic acid solution on 2 week-period treatment for granular myringitis
Protocol Title(Thai)	:	ประสิทธิผลของกรดน้ำส้มสายชูความเข้มข้น 1% และ 2% ในการรักษาภาวะเยื่อแก้วหูอักเสบแบบแกรนูลาร์ในระยะสองสัปดาห์
SIRB Protocol No.	:	1070/2563(IRB2)
Principal Investigator/Affiliation:		Assist. Prof.Sarun Prakairungthong, M.D. / Department of Oto – Rhino – Laryngology Faculty of Medicine Siriraj Hospital, Mahidol University
Research site	:	Faculty of Medicine Siriraj Hospital
Duration of research	:	1 year 6 months
Approval date	:	March 15, 2021
Expired date	:	March 14, 2022

This is to certify that Siriraj Institutional Review Board is in full compliance with international guidelines for human research protection such as the Declaration of Helsinki, the Belmont Report, CIOMS Guidelines and the International Conference on Harmonization in Good Clinical Practice (ICH-GCP)

(Assoc. Prof. Siriporn Pitimana-aree, M.D.)
Chairperson

22 MAR 2021
date

(Prof.Dr. Prasit Watanapa, M.D., Ph.D.)
Dean of Faculty of Medicine Siriraj Hospital

23 MAR 2021
date

Approval includes :

1. SIRB submission form
2. Participant information sheet, date March 5, 2021
3. Informed consent form, date February 18, 2021
4. Case record form
5. Curriculum vitae

Page 1 / 2

2 WANGLANG Rd.
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BANGKOK 10700

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Siriraj Institutional Review Board

Certificate of Approval (Renewal)

COA no. SI 208/2021

Protocol Title(English)	:	Effectiveness of 1% and 2% acetic acid solution on 2 week-period treatment for granular myringitis
Protocol Title(Thai)	:	ประสิทธิผลของกรดน้ำส้มสายชูความเข้มข้น 1% และ 2% ในการรักษาภาวะเยื่อแก้วหูอักเสบแบบแกรนูลาร์ในระยะสองสัปดาห์
SIRB Protocol No.	:	1070/2563(IRB2)
Principal Investigator/Affiliation:		Assist. Prof.Sarun Prakairungthong, M.D. / Department of Oto – Rhino – Laryngology Faculty of Medicine Siriraj Hospital, Mahidol University
Research site	:	Faculty of Medicine Siriraj Hospital
Duration of research	:	1 year 6 months
Renewal date (1st)	:	March 15, 2022
Expired date	:	March 14, 2023

This is to certify that Siriraj Institutional Review Board is in full compliance with international guidelines for human research protection such as the Declaration of Helsinki, the Belmont Report, CIOMS Guidelines and the International Conference on Harmonization in Good Clinical Practice (ICH-GCP)

(Assoc. Prof.Nisarat Opartkiattikul, M.D., Ph.D.)
Chairperson

29 APR 2022
date

(Prof.Prasit Watanapa, M.D., Ph.D.)
Dean of Faculty of Medicine Siriraj Hospital

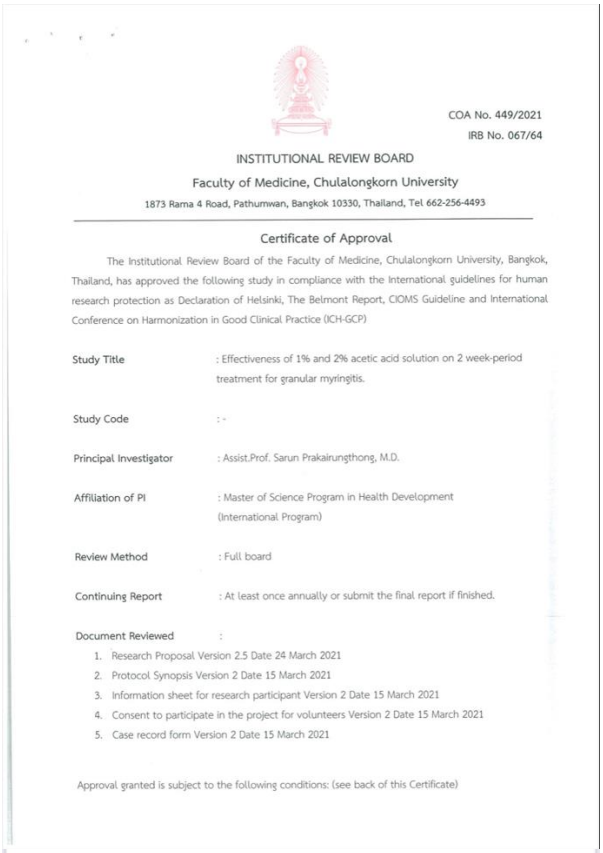
- 2 MAY 2022
date

Approval includes :

1. SIRB submission form
2. Participant information sheet, date March 5, 2021
3. Informed consent form, date February 18, 2021
4. Case record form
5. Curriculum vitae

Page 1 / 2

Appendix 3 ethical approval Chulalongkorn



COA No. 449/2021
IRB No. 067/64

INSTITUTIONAL REVIEW BOARD
Faculty of Medicine, Chulalongkorn University
1873 Rama 4 Road, Pathumwan, Bangkok 10330, Thailand, Tel 662-256-4493

Certificate of Approval

The Institutional Review Board of the Faculty of Medicine, Chulalongkorn University, Bangkok, Thailand, has approved the following study in compliance with the International guidelines for human research protection as Declaration of Helsinki, The Belmont Report, CIOMS Guideline and International Conference on Harmonization in Good Clinical Practice (ICH-GCP)

Study Title : Effectiveness of 1% and 2% acetic acid solution on 2 week-period treatment for granular myringitis.

Study Code : -

Principal Investigator : Assist.Prof. Sarun Prakairungthong, M.D.

Affiliation of PI : Master of Science Program in Health Development (International Program)

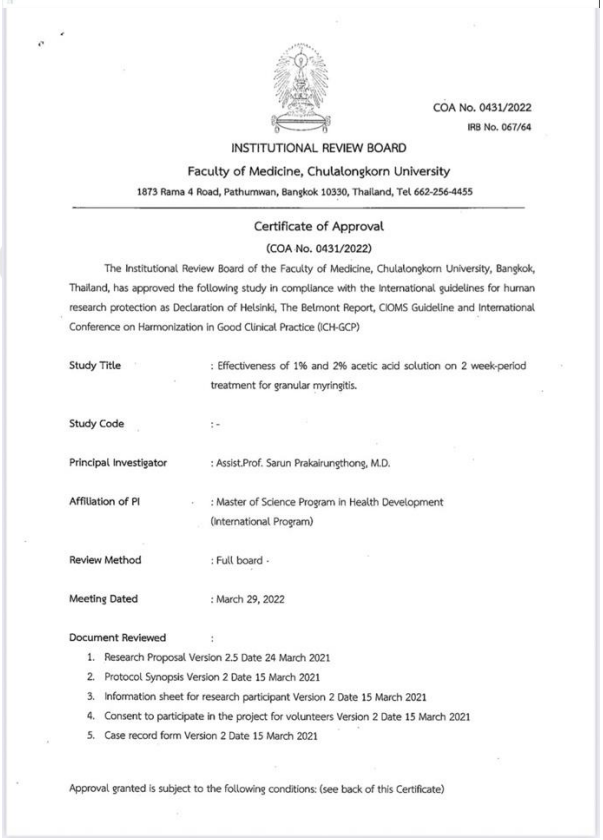
Review Method : Full board

Continuing Report : At least once annually or submit the final report if finished.

Document Reviewed :

1. Research Proposal Version 2.5 Date 24 March 2021
2. Protocol Synopsis Version 2 Date 15 March 2021
3. Information sheet for research participant Version 2 Date 15 March 2021
4. Consent to participate in the project for volunteers Version 2 Date 15 March 2021
5. Case record form Version 2 Date 15 March 2021

Approval granted is subject to the following conditions: (see back of this Certificate)



COA No. 0431/2022
IRB No. 067/64

INSTITUTIONAL REVIEW BOARD
Faculty of Medicine, Chulalongkorn University
1873 Rama 4 Road, Pathumwan, Bangkok 10330, Thailand, Tel 662-256-4455

Certificate of Approval
(COA No. 0431/2022)

The Institutional Review Board of the Faculty of Medicine, Chulalongkorn University, Bangkok, Thailand, has approved the following study in compliance with the International guidelines for human research protection as Declaration of Helsinki, The Belmont Report, CIOMS Guideline and International Conference on Harmonization in Good Clinical Practice (ICH-GCP)

Study Title : Effectiveness of 1% and 2% acetic acid solution on 2 week-period treatment for granular myringitis.

Study Code : -

Principal Investigator : Assist.Prof. Sarun Prakairungthong, M.D.

Affiliation of PI : Master of Science Program in Health Development (International Program)

Review Method : Full board

Meeting Dated : March 29, 2022

Document Reviewed :

1. Research Proposal Version 2.5 Date 24 March 2021
2. Protocol Synopsis Version 2 Date 15 March 2021
3. Information sheet for research participant Version 2 Date 15 March 2021
4. Consent to participate in the project for volunteers Version 2 Date 15 March 2021
5. Case record form Version 2 Date 15 March 2021

Approval granted is subject to the following conditions: (see back of this Certificate)

Appendix 4 Ethical approval Lerdsin

คณะกรรมการจริยธรรมการวิจัยในมนุษย์
โรงพยาบาลเลิดสิน กรมการแพทย์ กระทรวงสาธารณสุข
190 ถนนสีลม เขตบางรัก กรุงเทพมหานคร 10500 โทร 0 2353 9734

เลขที่หนังสือ 075

เอกสารรับรองการพิจารณาจริยธรรมโครงการวิจัย

คณะกรรมการจริยธรรมการวิจัยในมนุษย์ โรงพยาบาลเลิดสิน ได้พิจารณาอนุมัติโครงการวิจัยนี้โดยดำเนินการตามแนวทางหลักจริยธรรมการวิจัยในมนุษย์ที่เป็นมาตรฐานสากล ได้แก่ ปฏิญญาเฮลซิงกิ (Declaration of Helsinki), รายงานเบลมองต์ (The Belmont Report), CIOMS Guideline International Conference on Harmonization in Good Clinical Practice หรือ ICH-GCP และ 45CFR 46.101(b)

ชื่อโครงการวิจัย ประสิทธิผลของกรดน้ำส้มสายชูความเข้มข้น 1% และ 2% ในการรักษา ภาวะเยื่อแก้วหูอักเสบแบบแกรนูลาท์ ในระยะสองสัปดาห์
รหัสโครงการวิจัย LH641019
ชื่อผู้วิจัยหลัก นางสาวอัญสมร จันทรวิวัฒน์
รูปแบบการเข้ารับพิจารณา การขอปรับแก้ไขตามมติคณะกรรมการ (Resubmission)
เอกสารรับรอง

โปรโตคอล:	ฉบับที่ 2	28 มิถุนายน 2564
เอกสารแนะนำอาสาสมัคร:	ฉบับที่ 2	28 มิถุนายน 2564
เอกสารแสดงความยินยอม:	ฉบับที่ 1	29 มีนาคม 2564
แบบบันทึกข้อมูล:	ฉบับที่ 1	29 มีนาคม 2564

ลงนาม
(นางปฐมาภรณ์ สุรวงษ์สิน)
ประธานคณะกรรมการจริยธรรมการวิจัยในมนุษย์
โรงพยาบาลเลิดสิน

ลงนาม
(นายศักรินทร์ วงศ์เลิดศิริ)
ผู้อำนวยการโรงพยาบาลเลิดสิน

วันที่รับรองการพิจารณาจริยธรรม : 30 มิถุนายน 2564
วันที่หมดอายุการรับรองการพิจารณาจริยธรรม : 30 มิถุนายน 2565

Appendix 5 Ethical approval Somdejprapinklao

คณะกรรมการจริยธรรมการวิจัย กรมแพทย์ทหารเรือ Research Ethics Committee Naval Medical Department	
เอกสารรับรองโครงการวิจัย (Certificate of Approval : COA)	NMD 03.2_R05 No.029 COA-NMD-REC 029/65 Full Board Review ต่ออายุครั้งที่ 1

โครงการวิจัย และเอกสารประกอบตามรายการที่แสดงด้านล่างนี้ ได้รับการพิจารณาจากคณะกรรมการจริยธรรมการวิจัย กรมแพทย์ทหารเรือแล้ว มีความเห็นว่าข้อเสนอการวิจัยที่จะดำเนินการมีความสอดคล้องกับหลักจริยธรรมสากล ตลอดจนข้อบังคับและข้อกำหนดของกรมแพทย์ทหารเรือ จึงเห็นสมควรให้ดำเนินการวิจัยตามข้อเสนอการวิจัยนี้ได้

ชื่อโครงการ	ประสิทธิผลของกรดน้ำส้มสายชูความเข้มข้น 1% และ 2% ในการรักษาภาวะเยื่อแก้วหูอักเสบแบบแกรนูลารีในระยะสองสัปดาห์
ชื่อหัวหน้าโครงการ	นาวาโทหญิง ลลิดา หว่านพืชน์
หน่วยงานที่สังกัด	โรงพยาบาลสมเด็จพระปิ่นเกล้า กรมแพทย์ทหารเรือ
รหัสโครงการ	RP013/64
สถานที่ทำวิจัย	โรงพยาบาลสมเด็จพระปิ่นเกล้า กรมแพทย์ทหารเรือ
รายการเอกสารที่รับรอง	1) โครงการวิจัย (Version 2, วันที่ 12 พฤษภาคม 2565) 2) เอกสารชี้แจงข้อมูลแก่ผู้เข้าร่วมโครงการวิจัย (Version 2, วันที่ 12 พฤษภาคม 2565) 3) หนังสือแสดงเจตนายินยอมเข้าร่วมการวิจัย (Version 2, วันที่ 12 พฤษภาคม 2565)
วันที่รับรอง	23 พฤษภาคม 2565
วันหมดอายุ	22 พฤษภาคม 2566

นาวาเอก .....
(ปิยะวัฒน์ ศิริสวาง)
ประธานคณะกรรมการจริยธรรมการวิจัย พร.

เอกสารรับรองโครงการวิจัย (Certificate of Approval, COA) โดย คณะกรรมการจริยธรรมการวิจัย กรมแพทย์ทหารเรือ	
สำนักงานจริยธรรมการวิจัย กรมแพทย์ทหารเรือ อาคาร 304/54 อาคารกองโรคติดเชื้อกรมแพทย์ทหารเรือ บุคคโล ธนบุรี กทม.10600 โทร.02-4752705	NO.020 COA-NMD-REC 020/64 : Full Board Review
หมายเหตุ : ผู้ผลการวิจัย โดยผลงานการวิจัยในมนุษย์ที่ดำเนินการในสถานพยาบาลของ ทร. หรือดำเนินการโดยบุคลากรสังกัด ทร หรือบุคลากรภายนอกสังกัด ทร หรือมีโปรแกรมเกี่ยวข้องกับ ทร./นโยบาย ทร./ งานที่อาศัยหลักการศึกษาวิจัยในสัตว์ทดลองหรือในมนุษย์ ทร. และผู้ถือครองหลักจริยธรรมสากล	

โครงการวิจัย และเอกสารประกอบตามรายการที่แสดงด้านล่างนี้ ได้รับการพิจารณาจากคณะกรรมการจริยธรรมการวิจัย กรมแพทย์ทหารเรือแล้ว มีความเห็นว่าข้อเสนอการวิจัยที่จะดำเนินการมีความสอดคล้องกับหลักจริยธรรมสากล ตลอดจนข้อบังคับและข้อกำหนดของกรมแพทย์ทหารเรือ จึงเห็นสมควรให้ดำเนินการวิจัยตามข้อเสนอการวิจัยนี้ได้

ชื่อโครงการ	ประสิทธิผลของกรดน้ำส้มสายชูความเข้มข้น 1% และ 2% ในการรักษาภาวะเยื่อแก้วหูอักเสบแบบแกรนูลารีในระยะสองสัปดาห์
ชื่อหัวหน้าโครงการ/ หน่วยงานที่สังกัด	ว่าที่นาวาโทหญิง ลลิดา หว่านพืชน์ โรงพยาบาลสมเด็จพระปิ่นเกล้า กรมแพทย์ทหารเรือ
รหัสโครงการ	RP013/64
สถานที่ทำวิจัย	โรงพยาบาลสมเด็จพระปิ่นเกล้า กรมแพทย์ทหารเรือ
รายการเอกสารที่รับรอง	1) โครงการวิจัย (Version 2, วันที่ 12 พ.ค.2564) 2) เอกสารชี้แจงข้อมูลแก่ผู้เข้าร่วมโครงการวิจัย (Version 2, วันที่ 12 พ.ค.2564) 3) หนังสือแสดงเจตนายินยอมเข้าร่วมการวิจัย (Version 2, วันที่ 12 พ.ค.2564)
วันที่รับรอง	24 พฤษภาคม 2564
วันหมดอายุ	23 พฤษภาคม 2565

ทั้งนี้ผู้วิจัยต้องดำเนินการวิจัยตามข้อกำหนดและเงื่อนไข ที่ผู้วิจัยต้องปฏิบัติสำหรับโครงการวิจัยที่ได้รับการรับรองจากคณะกรรมการจริยธรรมการวิจัย กรมแพทย์ทหารเรือ ตามรายละเอียดใน FM-NMD-REC-12.1 ที่แนบ

พลเรือตรีหญิง.....
(พันทิพพร พันธุ์เสียรส)
ประธานคณะกรรมการจริยธรรมการวิจัย พร.

FM-NMD-REC-12 (R03) JAN16

VITA

NAME	ศรัญ ประกายรุ้งทอง
DATE OF BIRTH	10 มิถุนายน 2514
PLACE OF BIRTH	กรุงเทพมหานคร
INSTITUTIONS ATTENDED	ภาควิชา โสต นาสิก ลาริงซ์วิทยา คณะแพทยศาสตร์ศิริราชพยาบาล โรงพยาบาลศิริราช
HOME ADDRESS	225/18 ซอย สิทธิชัย ถนน กรุงเทพ-นนทบุรี แขวง วงศ์สว่าง เขต บางซื่อ กรุงเทพมหานคร 10800
PUBLICATION	1. Chongvisal S, Prakairungthong S, Limviriyakul S. Cochlear Implantation; Siriraj Experiences. Siriraj Medical Journal 2009;61:283-286 2. Prakairungthong S, Limviriyakul S, Chongvisal S. Acute Unilatreral Facial Paralysis in Child From Intra-Aural Hard Tick. Otology & Neurotology 2012;33(9):e81-82 3. Tantinikorn W, Assanasen P, Prakairungthong S. Mastoid Obliteration with Postconchal Soft Tissue and Postauricular Pericranial Flap. J Med Assoc Thai 2012;95(10):1306-11 4. Prakairungthong S, Thongyai K, Chongvisal S, Limviriyakul S, Srisomboon P, Suvarnsit K. Hearing Gain with Tailor-made Polyethylene Strut in Total Stapedectomy. Siriraj Medical Journal 2017;69(1):18-23 5. Sattaratpaijit N, Limviriyakul S, Thongyai K, Chongvisal S, Prakairungthong S. Subjective Visual Vertical in Post Total Stapedectomy with Tailored-Made Polyethylene Strut. J Med Assoc Thai 2017;100(6):649-653 6. Phonpornpaiboon P, Suvarnsit K, Prakairungthong S. Re-evaluation of Rinne Test with Aluminium Alloy

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8. Suvarnsit K, Chantarawiwat T, Prakairungthong S, Limviriyakul S, Atipas S, Pitathawatchai P. Granular Myringitis Treatment at Siriraj Hospital. Siriraj Medical Journal 2020;72(6):502-507

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