

The Effect of Ear Drainage and Middle Ear Inflammation due to Chronic Otitis Media on Infrared Tympanic Temperature Measurement

ABSTRACT

Background: The effect of ear drainage and middle ear inflammation due to chronic otitis media (COM) on infrared tympanic temperature measurement (ITTM) has not been demonstrated so far. This study aimed to reveal these effects.

Methods: Sixty patients with one perforated ear and one contralateral intact ear were included. These patients were divided into 2 groups. Group 1 included 30 patients with draining ears and inflamed middle ear mucosa, and group 2 included 30 patients with no drainage for the last 3 months and with normal middle ear mucosa. Tympanic temperature measurements were done for all ears in both groups. The data obtained from both groups were compared between and within groups.

Results: Mean perforated ear temperature and mean intact ear temperature were $36.95 \pm 0.67^\circ\text{C}$ and $36.74 \pm 0.67^\circ\text{C}$, respectively, in group 1. This difference was statistically significant. In group 2, no statistically significant difference was found between the mean perforated ear temperature ($36.87 \pm 0.51^\circ\text{C}$) and the mean intact ear temperature ($36.84 \pm 0.51^\circ\text{C}$). A comparison of the perforated ears and the intact ears between the groups revealed no significant difference.

Conclusion: Although ear drainage and middle ear inflammation due to COM may lead a slight elevation in tympanic temperature, this elevation is not clinically significant. Neither wet perforation nor dry tympanic membrane perforations affect tympanic temperature. ITTM may still be a reliable method for temperature measurement in patients with COM.

Keywords: Chronic otitis media, dry ear, infrared tympanic temperature, wet ear

INTRODUCTION

A fever is defined as a body temperature over 38.0°C , and is observed frequently with infectious, autoimmune, and malignant diseases.¹ The measurement of body temperature has an important role in the follow-up of all these diseases. Various body sites can be used for body temperature measurements, including the rectum, the oral cavity, the esophagus, and the tympanic membrane.² Each of these locations has its own advantages and disadvantages.³ Infrared tympanic temperature measurement (ITTM) is used in many cases, since it is easily applicable, yields a rapid result, and is noninvasive. In this method, the radiant heat emitted from the tympanic membrane is measured.⁴ Although it is frequently applied, there are limited studies about ear pathologies that may affect the results of ITTM. In addition, an otoscopic examination is not routinely performed before the measurement, and many undiagnosed ear pathologies may significantly affect the result. Therefore, the role of tympanic membrane pathologies on ITTM is investigated in this study.

Chronic otitis media (COM) refers to inflammation and infection in the mastoid cavity and middle ear and is characterized by the permanent perforation of the tympanic membrane.⁵ It is among the most common ear pathologies. An ear with COM, with drainage and middle ear infection, is called the wet ear, and such an ear without drainage and middle ear inflammation is called a dry ear. An ear with COM occasionally switches from one form to the other.⁶ Especially in a wet ear, drainage and middle ear inflammation may have an effect on the ITTM. Therefore, it is necessary to reveal the effect of ear drainage and middle ear inflammation due to COM on ITTM.



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In the present study, the effects of ear drainage and middle ear inflammation due to COM on ITTM were investigated.

METHODS

This study was performed in the Department of Otolaryngology Head and Neck Surgery at Yozgat Bozok University following Yozgat Bozok University Clinical Research Ethics Committee approval (Approval No: 2017-KAEK-189_2020.01.08_03). Sixty patients with COM in one ear (perforated ear) and with a healthy contralateral ear (intact ear) were included. Written informed consent was obtained from all participants. Patients with any infectious or inflammatory disease that may cause fever, patients with malignancy, patients with external auditory canal pathology (external otitis, malignancy, atresia, etc.), patients with adhesive otitis media, patients with cholesteatoma, and patients aged younger than 18 years or older than 65 years were excluded from the study. There were 34 females and 26 males, with 17 females and 13 males in each group. The mean age of the patients was 43.85 ± 16.87 years. There was no statistically significant difference between the age of participants in the 2 groups. Demographic data are given in Table 1. The study was designed to include 30 patients in each group. Group 1 (wet perforation group) included patients with a draining ear and inflamed middle ear mucosa, while group 2 (dry perforation group) included patients with no drainage for the preceding 3 months and normal middle ear mucosa. It was ensured that the tympanic membrane was completely visible in both ears of the patients prior to measurement. All measurements were performed by the same ENT specialist with the same device. The temperatures were measured in the Celsius mode. Three measurements were performed in each ear and the average value was accepted as the result. There was a two-minute interval between measurements. The temperatures measured in the perforated ear and healthy ear were defined as perforated ear temperature and intact ear temperature respectively. Intragroup and intergroup comparisons of the perforated ear temperatures and the middle ear temperatures were made.

Statistical analyses were performed using the Statistical Package for Social Science (SPSS) version 15.0 (SPSS Inc.; Chicago, Illinois, USA). The variables were investigated using visual (histograms, probability plots) and analytical methods (Kolmogorov–Smirnov test) to determine whether or not they were normally distributed. The paired samples *t*-test was run to compare the perforated ear temperatures with the intact ear temperatures in both groups. The independent samples *t*-test

MAIN POINTS

- Ear drainage and middle ear inflammation due to chronic otitis media (COM) may lead to a slight elevation in tympanic temperature, and this elevation is not clinically significant.
- Neither wet nor dry tympanic membrane perforations affect tympanic temperature measurement.
- Infrared tympanic temperature measurement (ITTM) is a reliable method to measure temperature in patients with COM.

Table 1. Demographic Data of Groups 1 and 2

	Group 1 (Wet Perforation)	Group 2 (Dry Perforation)
Age	42.4	45.3
Sex	17 F	17 F
	13 M	13 M
Perforation side	18 RE	14 RE
	12 LE	16 LE
Days since beginning of the last drainage (Mean)	12.7 days	171 days

F, female; M, male; RE, right ear; LE, left ear.

was used for comparison of perforated ear temperatures in both the groups, and also for comparison of the intact ear temperatures in both the groups. A *P*-value of less than .05 was considered a statistically significant result.

RESULTS

In group 1, the mean perforated ear temperature was $36.95 \pm 0.67^\circ\text{C}$, and the mean intact ear temperature was $36.74 \pm 0.67^\circ\text{C}$ (Table 2). This difference was statistically significant (Table 2, *P* = .004). In group 2, the mean perforated ear temperature was $36.87 \pm 0.51^\circ\text{C}$, and the mean intact ear temperature was $36.84 \pm 0.51^\circ\text{C}$ (Table 2). This difference was not statistically significant (Table 2, *P* = .585). The comparison of perforated ear temperatures between groups 1 and 2 revealed no statistically significant difference (Table 3, *P* = .610). Similarly, the comparison between intact ear temperatures between groups 1 and 2 revealed no statistically significant difference (Table 3, *P* = .528).

DISCUSSION

There are few studies investigating the effect of ear pathologies on ITTM results, although it is performed on the ear. These pathologies are not noticed during temperature measurement unless a prior otoscopic examination is done. In order to increase the clinical reliability of ITTM, the effect of frequently observed ear pathologies on ITTM should be clearly demonstrated. The temperature measurement obtained from a tissue is directly associated with the amount of blood flow in that tissue.⁷ ITTM measures the heat radiating from the tympanic membrane. There are 3 main structures affecting ITTM: the internal carotid artery, the internal jugular vein, and the blood circulating in the

Table 2. Comparison of Perforated Ears with Intact Ears in Groups 1 and 2

	Perforated Ear Temperature (Mean \pm SD)	Intact Ear Temperature (Mean \pm SD)	<i>P</i>
Group 1 (wet perforation)	36.95 ± 0.67	36.74 ± 0.67	.004 ^a
Group 2 (dry perforation)	36.87 ± 0.51	36.84 ± 0.51	.585 ^a

^aStatistically significant. ^oPaired samples *t*-test.

Table 3. Comparison of Perforated and Intact Ears in Groups 1 and 2

	Group 1 (Wet Perforation)	Group 2 (Dry Perforation)	P
Perforated ear temperature (mean ± SD)	36.95 ± 0.67	36.87 ± 0.51	.610 ^b
Intact ear temperature (mean ± SD)	36.74 ± 0.67	36.84 ± 0.51	.528 ^b

^bIndependent samples t-test.

tympanic membrane.⁸ The structures determining the temperatures measured in an ear with a healthy tympanic membrane are the major vessels, since blood circulating in the tympanic membrane is low.⁸ Pathologies between major vessels and the measuring instrument can affect the ITTM results. Therefore, external auditory canal and middle ear pathologies may have a significant effect on ITTM. Obstruction of the external auditory canal with cerumen is one of the most common ear pathologies. In literature, an external auditory canal obstructed with cerumen was found to be a causative factor for a lower ITTM result.^{9,10} This may have occurred due to the insulating effect of the cerumen between the measuring instrument and major vessels. The largest difference obtained in these studies was 0.62°C, and there are also studies reporting a smaller difference. The clinical significance of this difference is also limited. Studies suggest that otitis media with effusion, and acute otitis media do not affect ITTM.¹¹⁻¹³ Jolin et al.¹⁴ identified a difference in the infrared emission scores of patients with and without acute otitis media, but this difference is also clinically insignificant. There are few studies that have examined the effect of ear surgeries on ITTM. Pandey et al.,¹⁵ in their study, determined that minor ear surgery did not alter the results of ITTM. In a study by Schmal et al.,¹⁶ infrared temperature measurements obtained from the ear that was subjected to a canal wall down procedure were found to be higher than those obtained from the healthy ears. In this study, the difference associated with this procedure is 0.66°C. This result may be due to the fact that the structures between the major vessels and the measuring instrument are removed in this procedure. In addition, many studies to date have revealed the ineffectiveness of the dry tympanic membrane perforation on ITTM.^{3,9,16} In the present study, the measurements from dry perforations (group 2) with normal middle ear mucosa and measurements from healthy ears (intact ears) did not show any statistically significant difference, indicating no clear effect of dry perforation on ITTM, as in the previous studies. However, the effect of wet perforation has not been studied previously. The present study is unique in that respect. Although statistically significant elevation in temperature is detected in wet perforations (group 1) compared to healthy ears (intact ear), it is not clinically significant (Figure 1, Table 2). This may be due to the heat produced secondary to inflammation, but may also be associated with the increased blood flow with a higher amount of metabolic products. Whatever it is related to, it may be said that neither wet perforation nor dry perforation has a clinical effect on ITTM.

Previous studies, and this particular study as well, reveal that the effect of either wet or dry perforation may be ignored in ITTM, and ITTM is a reliable method in wet perforations as well as in dry perforations.^{3,9,16} In addition, ITTM can be used safely in ears with bilateral perforation.

Participants with COM in a single ear were included in this study. It was aimed to demonstrate the effect of only the pathological

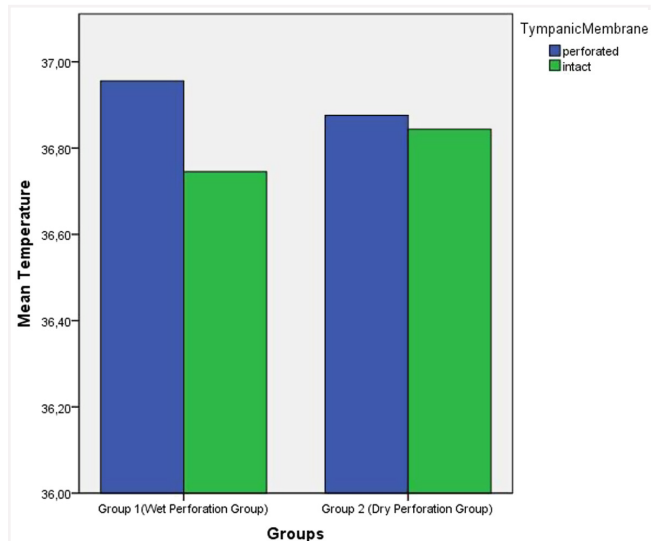


Figure 1. Graphical illustration of mean perforated ear temperature and mean intact ear temperature in Groups 1 and 2.

condition on ITTM, by comparing the temperature measurement obtained from the perforated ear with that obtained from the intact ear, for the same patient. This is the strength of this study. The small sample size can be regarded as the major limitation of the present study. Future studies involving a larger number of patients, and patients with other ear pathologies such as cholesteatoma, can further contribute to literature in this regard.

CONCLUSION

Ear drainage and middle ear inflammation due to COM may lead to a slight elevation in ITTM. This elevation is clinically insignificant. Both dry and wet tympanic membrane perforations do not have a clinically significant effect on ITTM. ITTM is a reliable method of temperature measurement in an ear with COM.

Ethics Committee Approval: Ethics committee approval was received from the Yozgat Bozok University clinical research ethics committee (2017-KAEK-189_2020.01.08_03).

Informed Consent: Written informed consent was obtained from all participants who participated in this study.

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