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# Chronic Suppurative Otitis Media, Caloric Testing, and Rotational Chair Testing

Gerard J. Gianoli and James S. Soileau

*The Ear and Balance Institute, Baton Rouge, Louisiana, U.S.A.*

**Objective:** To determine the incidence of caloric and rotational chair testing (ROT) abnormalities in a group of patients with chronic suppurative otitis media (CSOM) and to correlate caloric test results with ROT.
**Patients:** Twenty-five patients with CSOM with or without cholesteatoma who were to undergo tympanomastoid surgery.
**Interventions:** Caloric and ROT.
**Main Outcome Measures:** History of dizziness. Vestibular test abnormalities defined by caloric weakness (CW), reduced gain, abnormal phase, or asymmetry on ROT.
**Results:** Among the 25 patients, 13 had bilateral CSOM—most with long-standing disease and history of previous surgical intervention. Of the 25 patients, 19 (76%) demonstrated either unilateral or bilateral CW. Eighteen (72%) demonstrated abnormalities on ROT. Eleven patients (44%) had complaints of vertigo/dizziness, although 2 of these patients had both normal caloric testing and ROT. Unilateral or bilateral CW was 80% accurate in predicting an ROT abnormality, whereas the sympton of vertigo/dizziness was only 48% accurate in predicting an ROT abnormality.
**Conclusion:** The incidence of CW among CSOM patients in this study was high and correlated well with abnormalities on ROT. Interestingly, ROT results correlated better with CW than symptoms of dizziness/vertigo. Although CW findings can be the result of technical limitations in testing patients with CSOM, ROT corroboration of these results suggest that they are valid findings. **Key Words:** Chronic suppurative otitis media—Cholesteatma—Vestibular hypofunction—Rotary chair—ENG—Caloric testing.
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The medical literature is quite sparse regarding the outcome of vestibular testing in patients with chronic suppurative otitis media (CSOM)—consisting of mostly case reports. Furthermore, open-loop water caloric testing, the workhorse for vestibular testing, is technically difficult and many consider contraindicated in the face of CSOM. The alternative of using a closed-loop system overcomes some of the technical issues involved in caloric testing of the patient with CSOM. However, the simple fact that the anatomy in many of these patients is "asymmetric" (i.e., 1 ear may have a hole in the ear drum or the middle ear may be filled with cholesteatoma, fluid, or scar tissue) leads to the question of whether the results are measuring a true vestibular weakness or simply an asymmetric stimulation from differing transmission of thermal stimulation due to the anatomic asymmetry. Consequently, a unilateral caloric weakness (CW) found in a patient with CSOM has uncertain value. Is it artifactual or real?

Address correspondence and reprint requests to Gerard J. Gianoli, M.D., The Ear and Balance Institute, 17050 Medical Center Drive, Suite # 315, Baton Rouge, Louisiana 70816; E-mail: ggianoli@gmail.com

The purpose of this study is to evaluate the results of preoperative vestibular testing in patients with CSOM. To help analyze whether caloric test abnormalities are due to true inner ear pathologic findings and not just technical artifact, rotational chair testing (ROT) was accomplished. Furthermore, the findings of caloric testing and the symptom of dizziness will be correlated with ROT used as the gold standard to analyze sensitivity and specificity for each variable.

## METHODS

This study retrospectively reviews a series of patients who were diagnosed with CSOM and were scheduled for surgical intervention. All patients were evaluated preoperatively via a standard history and physical as well as vestibular testing. Patients were excluded from the study if they either had not completed the aforementioned tests or the chart lacked the data to be included in this study. Preoperative vestibular studies have become routine at our office for adult patients with CSOM.

Rotational chair testing was accomplished in a Micromedical 2000 (Chatham, IL, USA) rotary chair. Sinusoidal harmonic acceleration testing of the vestibuloocular reflex was performed for at least 6 different testing frequencies to be

**TABLE 1.** *Sensitivity, specificity, positive predictive value, and negative predictive value for caloric testing and the symptom of dizziness/vertigo for the prediction of rotary chair test results*

| | Sensitivity (%) | Specificity (%) | PPV (%) | NPV (%) |
|---|---|---|---|---|
| Any ROT abnormality | | | | |
| Caloric testing | 89 | 57 | 84 | 66 |
| Dizziness/vertigo | 44 | 57 | 73 | 29 |
| Gain/phase abnormality on ROT | | | | |
| Caloric testing | 100 | 46 | 63 | 100 |
| Dizziness/vertigo | 33 | 46 | 36 | 43 |
| Asymmetry on ROT | | | | |
| Caloric testing | 88 | 57 | 74 | 67 |
| Dizziness/vertigo | 44 | 56 | 63 | 36 |

NPV indicates negative predictive value; PPV, positive predictive value; ROT, rotational chair testing.

included in this study. Frequencies tested were 0.01, 0.02, 0.04, 0.08, 0.16, 0.32, and 0.64 Hz. Gain, phase, or asymmetry was considered to be abnormal if the results of at least 2 frequencies fell outside the range of the normative data supplied by the manufacturer.

Caloric testing was done on a Micromedical Visual Eyes 4-channel videonystagmography system using a Micromedical Airstar air irrigator with 27°C for cold irrigation and 44°C for warm irrigation. The irrigations lasted 60 seconds each. Unilateral CW was calculated by the Jonkees formula. Unilateral weakness was considered significant for any finding greater than 20%. A total eye speed of less than 35 was considered suspect for bilateral CW.

Sensitivity, specificity, positive predictive value, negative predictive value, and accuracy were calculated and compared for the symptom of dizziness and an abnormality on caloric testing. The gold standard used for these calculations was alternatively 1) any abnormality of gain, phase, or asymmetry on ROT, 2) gain/phase abnormality on ROT, or 3) abnormal asymmetry on ROT.

## RESULTS

Twenty-five patients were included in the study. Among these patients, 13 (52%) had bilateral CSOM, and 12 (48%) had unilateral CSOM. These patients were typically referred due to some complexity of the individual case, and most presented for revision tympanomastoid surgery. Three patients had horizontal semicircular canal fistulization from cholesteatoma, and 2 had stapes subluxation—1 by cholesteatoma and another iatrogenically from previous surgery. A history of dizziness/vertigo was elicited from 11 (44%) of the patients, although it was not a primary complaint of any of the patients.

Caloric testing was abnormal in 19 (76%) of the patients, with 14 demonstrating unilateral weakness and 5 demonstrating bilateral weakness. Rotational chair testing was abnormal in 18 (72%) patients. Twelve showed abnormalities on gain or phase, and 16 had an asymmetry on ROT. Statistics are presented in Tables 1 and 2.

## DISCUSSION

Caloric testing in the face of CSOM may present some unusual test results. In 1979, Paparella et al. (1) reported on air caloric test results among patients with unilateral otitis media before and after surgery. They concluded that tubes or a small perforation of 1 ear may show a caloric response equal to the intact side; large perforations on 1 side may show a hyperactive caloric response on the perforated side; a moist ear (with either a large perforation or a cavity) may show an inverted horizontal nystagmus to warm air caloric stimulation; and dry open mastoid or fenestration cavities were likely to show hyperactive caloric responses.

In 1993, Ben-David et al. (2) reported on the outcome of vestibular testing in 50 children with middle ear effusions (MEEs) who were scheduled for ventilation tube placement compared with 20 control patients. Preoperative and postoperative testing consisted of craniocorpography and ROT. They found no difference in test results between the 2 groups.

In 1998, Golz et al. (3) studied 136 children with MEE scheduled for ventilation tube placement and 74 control patients using electronystagmography (ENG) and the Bruininks-Oseretssky test for motor proficiency (BOT)—before and after tube placement. They reported abnormalities in 58% of the patients with MEE compared with 4% among the controls.

Kazmierczak et al. (4) studied 60 adult patients with chronic otitis media with ENG and stabilometric analysis. They reported that "inner ear dysfunction was mainly observed in cholesteatoma cases." Engel-Yeger et al. (5) studied 20 children with MEE and 20 controls with ENG and BOT. Although no abnormalities were noted on ENG in either group, the MEE group demonstrated significantly poorer results on the balance subtest of the BOT compared with the control group.

In 1995, Casselbrant et al. (6) they reported on 41 children with otitis media compared with 50 controls. The subjects were tested before and after ventilation tube insertion with moving-platform posturography. They found a significant increase in sway among the patients with otitis media compared with controls. In 1998 (7), they studied visually induced postural sway, concluding that children with otitis media with effusion

**TABLE 2.** *Accuracy for caloric testing and the symptom of dizziness/vertigo for the prediction of rotational chair test results*

| | Accuracy (%) |
|---|---|
| Any ROT abnormality | |
| Caloric testing | 80 |
| Dizziness/vertigo | 48 |
| Gain/phase abnormality on ROT | |
| Caloric testing | 72 |
| Dizziness/vertigo | 40 |
| Asymmetry on ROT | |
| Caloric testing | 72 |
| Dizziness/vertigo | 48 |

may be more visually dependent for balance than controls, suggesting that otitis media with effusion may affect vestibular function in these children. In 2000 (8), they studied 40 children with a history of MEE (and no active disease or effusion) and 31 controls using ROT and moving-platform posturography. A significant reduction in gain at 0.1 Hz on ROT was noted for the children with MEE compared with controls. They concluded that a previous history of MEE affected the vestibular system even after the MEE had resolved.

The present study demonstrates a high incidence (76%) of CW among this group of patients with CSOM. Considering the technical issues associated with caloric testing in patients with CSOM—namely, asymmetric stimulation due to differing middle ear contents—this is not surprising. However, the results from ROT are not affected by whether the patient has a perforation or whether the middle ear is filled with cholesteatoma. Both inner ears are stimulated identically in ROT. Consequently, the high degree of accuracy (80%) for caloric testing to predict ROT abnormalities lends support to the validity of caloric testing.

A number of possible causes for vestibular dysfunction in the face of CSOM come to mind. Although no single cause seems likely in all patients, too many factors are reasonably to blame for the CW or ROT abnormalities observed among the patient population—3 cases of horizontal semicircular canal fistulization by cholesteatoma, 2 cases of previous stapes subluxation, 2 cases of significant head trauma, 1 case of congenital inner ear dysplasia—and most had undergone previous surgery that places them at risk of iatrogenic vestibular injury.

One of the problems with this study is selection bias. The very high incidence of vestibular test abnormalities in this patient population cannot be extrapolated to the population of patients with CSOM at large. The study group was plagued with complex problems and was selected by their referral to a neurotology tertiary referral center. However, there was high degree of accuracy, sensitivity, and specificity of air caloric testing as a means to predict ROT abnormalities and a relatively poor accuracy for the symptom of dizziness. This seems to corroborate that air caloric testing is a better tool for the evaluation of vestibular dysfunction in CSOM than a history of dizziness or vertigo.

Another implication from this study is the importance of preoperative vestibular testing in patients with CSOM. Considering the high incidence of vestibular test abnormalities in this population, failure to document these abnormalities preoperatively can leave a surgeon vulnerable to litigation at a later date.

## CONCLUSION

1. There was a high incidence of abnormalities on caloric testing and ROT among the study population.
2. Caloric weakness correlated better and was a better predictor of ROT abnormalities than a history of dizziness or vertigo.
3. Rotational chair testing findings support the findings of caloric test results despite technical difficulties.
4. Documentation of preoperative vestibular function in patients with CSOM can have significant legal implications.

## REFERENCES


1. Paparella MM, Rybak L, Meyerhoff WL. Air caloric testing in otitis media. *Laryngoscope* 1979;89:708–14.
2. Ben-David J, Podoshin L, Fradis M, Faraggi D. Is the vestibular system affected by middle ear effusion. *Otolaryngol Head Neck Surg* 1993;109:421–6.
3. Golz A, Netzer A, Angel-Yerger B, Westerman ST, Gilbert LM, Joachim HZ. Effects of middle ear effusion on the vestibular system in children. *Otolaryngol Head Neck Surg* 1998;119:695–9.
4. Kazmierczak H, Pawlak-Osinska K, Kazmierczak W. Vestibular peripheral organ in chronic otitis media. *Otolaryngol Pol* 2003;57:877–80.
5. Engel-Yeger B, Golz A, Parush S. Impact of middle ear effusion on balance performance in children. *Disabil Rehabil* 2004;26:97–102.
6. Casselbrant ML, Furman JM, Rubenstein E, Mandel EM. Effect of otitis media on the vestibular system in children. *Ann Otol Rhinol Laryngol* 1995;104:620–4.
7. Casselbrant ML, Redfern MS, Furman JM, Fall PA, Mandel EM. Visual-induced postura sway in children with and without otitis media. *Ann Otol Rhinol Laryngol* 1998;104:401–5.
8. Casselbrant ML, Furman JM, Mandel EM, Fall PA, Kurs-Lasky M, Rockette HE. Past history of otitis media and balance in four-year-old children. *Laryngoscope* 2000;110:773–8.