

Sinonasal symptoms in adults with ear disease

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Abstract

Background: The association between eustachian tube dysfunction and middle-ear effusion is well established. Studies have also demonstrated pathological changes affecting the middle-ear mucosa associated with chronic sinonasal inflammation. No previous studies have evaluated symptoms related to sinonasal inflammatory disease in different ear diseases.

Objective: To assess the presence of sinonasal symptoms in ear diseases using the Dundee Rhinogram.

Methods: Data were collected prospectively in the period February–October 2011. Sinonasal symptoms were graded using the Dundee Rhinogram. Student's *t*-test analyses were performed to identify any statistically significant associations.

Results: In total, 164 patients were assessed. There was a statistically significant association between sinonasal symptoms and mucosal middle-ear diseases ($p < 0.005$). The mean sinonasal symptoms score for mucosal middle-ear disease patients was 5.94 (range, 0–32).

Conclusion: Assessment of sinonasal symptoms is paramount in patients presenting with an ear symptom; inflammatory sinonasal disease treatment may become necessary in the management of middle-ear mucosal disease for better patient outcome.

Key words: Ear Diseases; Nose Diseases; Paranasal Sinus Diseases; Pathophysiology

Introduction

The association between eustachian tube dysfunction and middle-ear effusion is well established, and studies have identified eustachian tube dysfunction as a major risk factor for benign middle-ear diseases.^{1–5} Previous studies have shown that a number of sinonasal diseases are associated with ear symptoms.^{6–10} Studies have also demonstrated pathological changes affecting the middle-ear mucosa that are associated with chronic sinonasal inflammatory diseases.^{11,12}

No previous studies have evaluated the presence or absence of symptoms related to sinonasal inflammatory conditions in different ear diseases. This study primarily aimed to assess the presence and degree of sinonasal symptoms in different ear diseases using the Dundee Rhinogram. The study also examined the correlation between sinonasal symptoms and specific subgroups of ear diseases.

Materials and methods

Study design and patients

A prospective cohort study was conducted in the period February–October 2011. A cohort of new and follow-

up adult patients attending the otology clinic was assessed for sinonasal symptoms using the Dundee Rhinogram (Figure 1). The degree of sinonasal symptomatology was graded (using the Dundee Rhinogram) in relation to various ear diseases. Questions concerning the presence or absence of sinonasal symptoms were asked as part of the clinical history process. A data proforma was designed and completed at the end of each consultation by the authors. Patients with cognitive impairment were excluded from the study.

Data gathering

Data were collected prospectively by all three authors and stored using an Excel spreadsheet. Diseases were classified into external-, middle- and inner-ear diseases. Data collected were subdivided into groups according to the type of ear disease. Group A comprised patients with external-ear diseases, group B represented middle-ear diseases, and group C represented inner-ear diseases. Group B was further subdivided into mucosal (B1) and squamous (B2) disease subtypes. Inactive squamous chronic otitis media

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Score	Pain	Headache	Block	Discharge	Hyposmia	Overall
0						
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
Total						

FIG. 1
The Dundee Rhinogram.

(retraction pockets, epidermisation and atelectasis) and active squamous chronic otitis media (i.e. acquired cholesteatoma) were considered under the umbrella of squamous middle-ear disease. Otitis media with effusion, and active or inactive mucosal chronic otitis media, were included under mucosal middle-ear diseases. The classification of ear diseases into each subgroup was confirmed by the senior author (SSMH).

Statistical analysis

Statistical analysis was conducted using SPSS statistical software, version 15 (Chicago, Illinois, USA). The Student’s *t*-test analysis for trend was performed to identify any statistically significant association between ear diseases and sinonasal symptoms. Associations between sinonasal symptoms and external-, middle- and inner-ear diseases were examined.

Ethical considerations

Local research and development department approval was formally obtained. No ethics approval was sought as the assessment did not affect the patient care at any level, and the questions asked were part of the routine ENT clinical history assessment. All study data were recorded and kept in accordance with Caldicott Guardianship protocols.

Results

There were 164 patients in the study (a male to female ratio of 9:11). Mean patient age was 50.4 years (range, 16–94 years). Groups A (external-ear disease), B (middle-ear disease) and C (inner-ear disease) each respectively comprised 15 per cent, 70 per cent (with 30 per cent in B1 (mucosal middle-ear disease) and 40 per cent in B2 (squamous middle-ear disease)) and 15 per cent of the whole population (Table I).

TABLE I PATIENT DATA		
Group	Patients (n (%))	Rhinogram score (mean (range))
A	25 (15)	0.80 (0–8)
B1	49 (30)	5.94 (0–32)
B2	66 (40)	0.72 (0–11)
C	24 (15)	1.65 (0–24)

Patients from groups A, B1, B2 and C scored respective averages of 0.80, 5.94, 0.72 and 1.65 on the Dundee Rhinogram (Table I). All patients were also asked about their previous ear operations. This information is summarised in Table II.

The rhinogram scores for each middle-ear disease patient (in subgroups B1 and B2) are shown in Figure 2. Patients in group B1 (mucosal middle-ear disease) scored considerably fewer zeros and had a higher mean score than those in group B2 (squamous middle-ear disease).

A Student’s *t*-test was performed using the mean rhinogram scores from the different groups (A, B1, B2 and C). This demonstrated no statistical differences between the group populations. No statistically significant association was demonstrated between sinonasal symptoms and (sub)groups A, B2 or C ($p = 0.057$). However, when the Student’s *t*-test was used to compare subgroups B1 and B2, there was a significant difference between the means of the two populations ($p = 0.003$), with unequal variances; the mean difference was 4.92. This finding is further supported by the graph in Figure 3.

Discussion

Principal results

The mean sinonasal symptom scores (based on the Dundee Rhinogram) for groups A (external-ear disease), B1 (mucosal middle-ear disease), B2 (squamous middle-ear disease) and C (inner-ear disease) were 0.8, 5.94, 0.72 and 1.65, respectively. There was no statistically significant association between sinonasal symptoms and external-ear, squamous middle-ear or inner-ear diseases ($p = 0.057$, Student’s *t*-test). However, the association between sinonasal symptoms and mucosal middle-ear disease was statistically significant ($p < 0.005$, Student’s *t*-test).

Oto-nasopharyngeal system

The eustachian tube, nasopharynx and mastoid air cells can be considered as a functional system, which helps in the ventilation, clearance and protection of the middle-ear cavity.^{3,9} Ventilation of the middle-ear cavity is primarily achieved by contraction of the tensor veli palatini muscle.¹⁰ The clearance and protection of the middle-ear cavity are maintained by the co-operation of the eustachian tube and other surrounding structures.^{3,5,10} It has also been suggested that different parts of the eustachian tube are responsible for different roles. For instance, the roof of the eustachian tube is primarily involved in ventilation, and the floor of the eustachian tube helps mainly with clearance, although both parts are responsible for protecting the middle-ear cavity.^{3,5,9,10}

Previous studies

The association between eustachian tube dysfunction and otitis media with effusion (OME) is well

TABLE II
PREVIOUS EAR OPERATIONS

Group	Canaloplasty	Tympanoplasty	Mastoid surgery	Ossiculoplasty	Myringoplasty	Grommets	Septoplasty
A	2	2	1	0	0	0	0
B1	0	2	1	2	3	1	0
B2	0	0	10	0	1	0	2
C	0	1	0	0	0	0	0

Data represent numbers of patients.

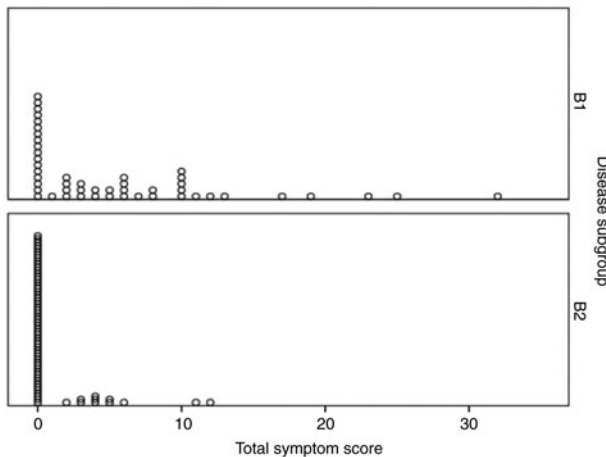


FIG. 2

Dundee Rhinogram symptom scores for each patient in subgroups B1 and B2.

established, predominantly based on studies of paediatric subjects.^{3,4,6,9} Furthermore, studies have identified eustachian tube dysfunction as a major risk factor for both squamous and inflammatory middle-ear diseases.^{6,11} Chronic eustachian tube dysfunction has been observed in a number of sinonasal diseases, including chronic rhinosinusitis (allergic or non-allergic), septal deformity and sinonasal polyposis.^{2,4–11} Studies have also demonstrated chronic inflammatory

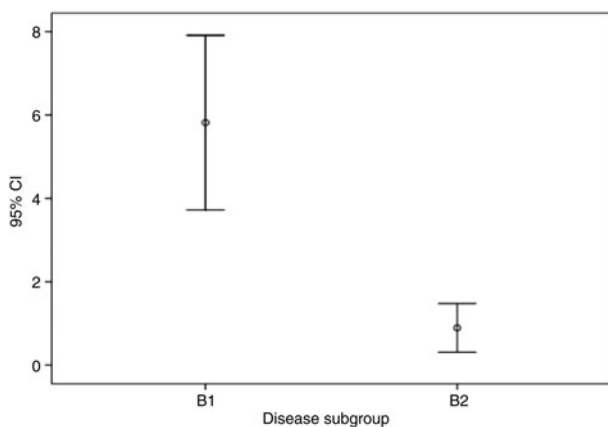


FIG. 3

Ninety-five per cent confidence intervals (CIs) for the mean Dundee Rhinogram symptom scores of subgroups B1 and B2; the lack of overlap of CIs indicates a significant difference between the two populations.

pathological changes affecting the middle-ear mucosa that are associated with chronic sinonasal inflammatory diseases.^{11,12}

The European position paper on rhinosinusitis and nasal polyps published in 2007 states that 40–68 per cent of patients with rhinosinusitis have complained of recurrent purulent otitis media or OME.¹³ This association with ear symptoms is due to eustachian tube dysfunction, which leads to negative middle-ear pressures, causing patients to develop recurrent purulent otitis media or OME.

Study merits

No previous studies have evaluated the presence or absence of sinonasal symptoms associated with specific anatomical ear diseases. This study has clearly demonstrated a statistically significant association between mucosal middle-ear diseases and sinonasal symptoms. It is not surprising there was no association between sinonasal symptoms and external- or inner-ear diseases, as there is no anatomical or physiological link between the eustachian tube and external- or inner-ear systems. The association with middle-ear diseases is more reasonable due to the middle-ear ventilation from the nasopharynx through the eustachian tube.

- **The association between eustachian tube dysfunction and middle-ear effusion is well established**
- **Pathological changes affecting middle-ear mucosa are associated with chronic sinonasal inflammation**
- **No previous studies have evaluated symptoms related to sinonasal inflammatory disease in different ear diseases**
- **This study demonstrated an association between mucosal middle-ear diseases and sinonasal symptoms, possibly due to inflammatory sinonasal diseases**
- **Assessment of sinonasal symptoms is paramount in patients presenting with an ear symptom**
- **Inflammatory sinonasal disease treatment may be necessary in middle-ear mucosal disease management**

Study limitations

This study makes no distinction between specific sinonasal inflammatory diseases; the aim was to ascertain an association between sinonasal symptoms and ear diseases. Furthermore, the number of patients in each subgroup varied; however, this did not affect the overall statistical analysis and correlation. This study cannot explain the lack of association between sinonasal symptoms and squamous middle-ear diseases, despite previous studies showing an association with eustachian tube dysfunction. Considering the pathogenesis of squamous middle-ear diseases, in particular acquired cholesteatoma, it is perhaps not surprising there was no direct association with sinonasal symptoms. We suspect that the association between squamous middle-ear diseases and eustachian tube dysfunction is indirect.

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