

# Sinonasal Polyposis and Its Effect on Eustachian Tube Function

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## ABSTRACT

**Objective/hypothesis:** Nasal and paranasal sinus disease can cause Eustachian tube (ET) dysfunction leading to middle ear (ME) hypoventilation. Persistent ME hypoventilation can result in ME conditions like retraction of tympanic membrane, otitis media with effusion, and chronic ME disease.

**Aim:** Aim of this study was to evaluate the ET function in cases of sinonasal polyposis. Evaluation was done by doing tympanometry.

**Materials and methods:** This was a hospital-based prospective study consisting of 42 patients (84 ears) of nasal polyposis, of which 27 patients had antrochoanal (AC) polyp and 15 patients had ethmoidal polypi. After thorough history and detail clinical examination, tympanometry was done in all patients 1 day prior to surgery and 4 to 6 weeks after surgery.

**Results:** Preoperatively in 30 ears (15 patients) of ethmoidal polypi had normal tympanogram (A type) in 40% ears and abnormal tympanogram (B and C) in 60% ears. Postoperatively 80% had A tympanograms and 20% had abnormal tympanogram. There was significant improvement on removal of polypi ( $p=0.004$ ). Preoperatively 54 ears (27 patients) of AC polyp had normal tympanogram (type A) in 55.56% ears and abnormal tympanogram (B and C) in 44.44% ears. Postoperatively normal tympanogram was seen in 81.48% and abnormal tympanogram in 18.52% ears, so there was significant improvement after functional endoscopic sinus surgery ( $p=0.007$ ).

**Conclusion:** Eustachian tube dysfunction was present preoperatively in 60 and 44.44% in ethmoidal and AC polypi respectively, while in postoperative period dysfunction was 20 and 18.52%. So function improves on removal of polyp.

**Keywords:** Eustachian tube, Nasal polyp, Otitis media with effusion, Tympanogram, Tympanometry.

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## INTRODUCTION

The discovery of communicating passage between middle ear (ME) and nasopharynx dates back to very earliest time. Although Alemond of Sparta recognized the existence of auditory tube as early as 500 B.C., Italian anatomist Bartolommeus Eustachius gave first description of it in 1563.<sup>1</sup>

Middle ear is gas filled biological gas pocket. All biological gas pockets face two special problems that they need to overcome: Shrinkage or reduced pressure because of net loss of gases into surrounding circulation and need to keep sac clean. In the ME these two problems have been overcome by ventilation and mucociliary transport through the Eustachian tube (ET).<sup>2</sup> Abnormal ET function as a factor in the pathogenesis of ME disease has been extensively documented in the literature. Nasal and paranasal sinus disease can cause ET dysfunction, leading to ME disease. Several studies have related nasal septal deviation to ET dysfunction.<sup>3</sup> Rajati et al<sup>4</sup> studied ME function in sinonasal polyposis and observed significant dysfunction on tympanometry.

This study was undertaken to know the effect of polyposis (ethmoidal and antrochoanal) on ET function and whether function would improve on removal of polyp. Among various methods available, the impedance audiometer is the most useful tool to determine ET function. It not only measures anatomical patency of ET but also its functional integrity. The tympanometry was performed in patients having ethmoidal and AC polyps 1 day prior to surgery and it was repeated 4 to 6 weeks after functional endoscopic sinus surgery.

## MATERIALS AND METHODS

This was a prospective study carried out at tertiary care hospital in rural area between December 2006 and October 2008. The protocol for this study was approved by college ethics committee and consent was obtained from all patients. A total of 42 patients of sinonasal polyposis were studied, of which 27 patients (64.28%) had AC polyp and 15 patients (35.71%) had ethmoidal polypi.

Detail history pertaining to ear, nose, and throat was taken. Thorough clinical examination (including general, systemic, and ENT) was done.

**Inclusion Criteria**

- Patients of AC polyp with intact drum.
- Patients of ethmoidal polypi with intact drum.

**Exclusion Criteria**

Patients of AC or ethmoidal polyposis with (1) Perforation of drum; (2) trauma to ear; (3) aural cholesteatoma; (4) acute ME infection.

Otomicroscopy, nasal endoscopy, pure tone audiometry were done. Tympanometry was performed in all the cases using impedance audiometer (MAICO MI34) prior to surgery and 4 to 6 weeks after surgery, and tympanogram was obtained. Tympanograms were classified as described by Jerger in 1975 in clinical experience with impedance audiometry.<sup>5</sup>

**RESULTS**

We studied a total of 42 patients in the age group of 10 to 60 years. Maximum were in age group 10 to 20 years (Table 1). Out of 42 patients of polyposis, 30 (71.43%) were males and 12 (28.57%) were females (Table 2).

**On Otoscopy**

- In 15 patients (30 ears) of ethmoidal polypi (Fig. 1) bilateral retraction was present in 6 patients (12 ears) and unilateral retraction in 3 patients (3 ears). In 6 patients (12 ears) tympanic membrane was normal on both sides. So 15 ears had normal drum and 15 ears had retracted drum.
- In 27 patients (54 ears) of AC polypi bilateral retraction of tympanic membrane was present in 6 patients (12 ears), unilateral otitis media with effusion (Fig. 2) in 6 patients, and normal drum on both sides in 15 patients (30 ears), thus 18 ears were having retracted drum and 36 ears had normal drum.

**On Tympanometry**

- Preoperatively in 30 ears of ethmoidal polypi, normal tympanogram (type A), i.e., normal ME pressure

**Table 1:** Age-wise distribution of cases (n = 42 patients)

Age group of patients	No. of patients	Percentage
10–20	15	35.72
21–30	8	19.04
31–40	5	11.90
41–50	10	23.81
51–60	4	9.53

**Table 2:** Gender-wise distribution of cases (n = 42 patients)

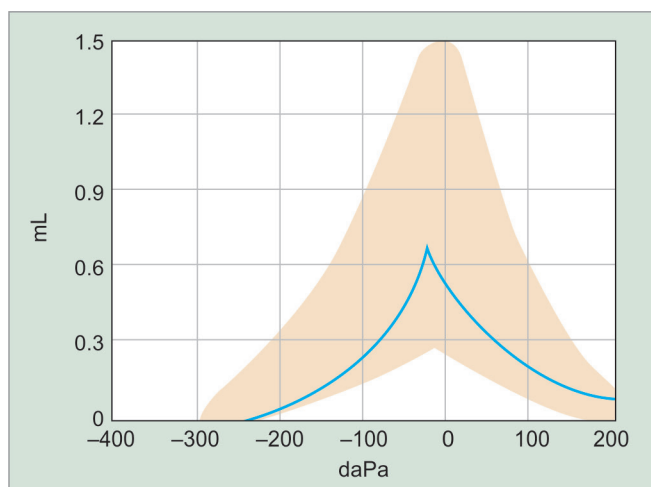
Gender	No. of patients	Percentage
Male	30	71.43
Female	12	28.57



**Fig. 1:** Nasal polyposis

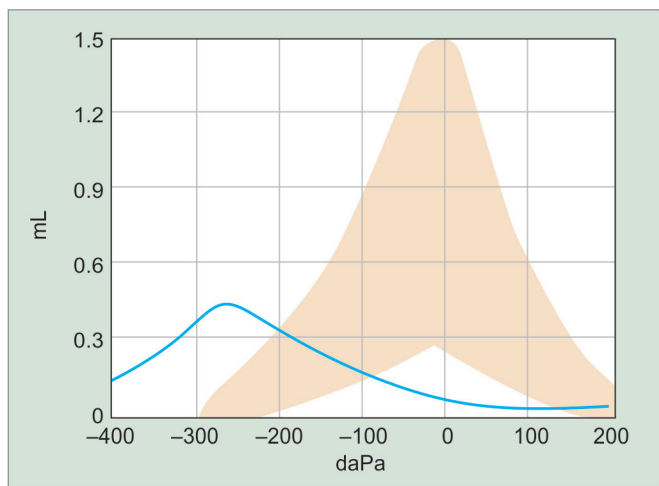


**Fig. 2:** Otitis media with effusion

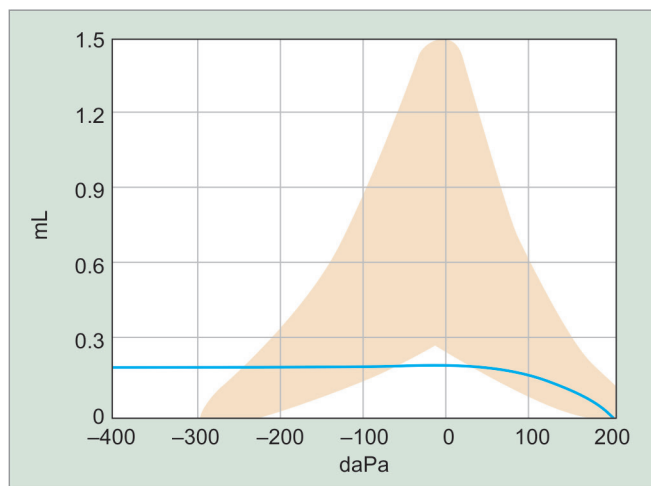


**Graph 1:** Type A tympanogram

and normal compliance (Graph 1), was present in 40% (12/30) ears. Abnormal tympanogram (type B and C) in 60% (18/30) ears. Type C tympanogram is characterized by significantly negative ME pressure ( $\leq 100$  daPa) and normal compliance curve. This



Graph 2: Type C tympanogram



Graph 3: Type B tympanogram

is usually found in ET dysfunction or obstruction (Graph 2). Type B tympanogram shows little or no maximum peak. Compliance remains unchanged over a large range of pressure variation, i.e., it shows flat curve. It is found in ears with serous or adhesive otitis media (Graph 3). Postoperatively 80% (24/30) had normal tympanogram and 20% (8/30) had abnormal tympanogram (Table 3). So, there is significant improvement on removal of polypi (p-value = 0.004).

- In 54 ears of antrochoanal polyp, normal tympanogram was found in 55.55% (30/54) ears and abnormal tympanogram in 44.44% (24/54) ears. Postoperatively normal tympanogram was seen in 81.48% (44/54) ears and abnormal tympanogram in 18.51% (10/54) ears (Table 4). So significant improvement was seen after polypectomy (p-value = 0.007).

**DISCUSSION**

Nasal polyposis is an inflammatory reaction involving mucous membrane of nose and paranasal sinuses.<sup>6</sup> There are different proposed etiological factors like allergy, aspirin sensitivity, fungal rhinosinusitis, cystic fibrosis, and primary ciliary dyskinesia. Polyps are covered by normal airway epithelium containing few nerves, blood vessels, and glands.

There are several explanations to account for the ET dysfunction associated with nasal diseases:

- Mechanical obstruction of ET orifice may occur due to nasal mass.<sup>7</sup>
- Increased secretions from seromucous glands in the pharyngeal portion of ET may accumulate and block the tube.<sup>8</sup>
- Lymphatic stasis due to edema of the submucosa of the tube resulting in compromise of the lumen may produce ET dysfunction.<sup>9</sup>

**Table 3:** Preoperative and postoperative tympanogram in ethmoidal polypi patients (n = 30 ears, i.e., 15 patients)

	Normal tympanograms (type A)	Abnormal tympanograms (type C and B)
Before surgery (n = 30 ears)	12 (40%)	18 (60%)
Four weeks after surgery (n = 30 ears)	24 (80%)	06 (20%)

Chi = 8.403, degree of freedom = 1, p = 0.004

**Table 4:** Preoperative and postoperative tympanogram in patients having AC polyps (n = 54 ears, i.e., 27 patients)

	Normal tympanograms (type A)	Abnormal tympanograms (type C and B)
Before surgery (n = 54 ears)	30 (55.56%)	24 (44.44%)
4–6 weeks after surgery (n = 54 ears)	44 (81.48%)	10 (18.52%)

Chi = 7.254, degree of freedom = 1, p = 0.007

- Further increase in hydrostatic pressure result in the accumulation of ME fluid by transudative process.<sup>10</sup>
- Tubal dysfunction may be related to deficiency of surfactant that is thought to facilitate tubal opening. It has been postulated that this material is inactivated by inflammation.<sup>11</sup>

It is important to know the impact of sinonasal disease on ET function. The effect of nasal obstruction due to sinonasal polyposis was studied in 42 subjects. ET dysfunction was present in 60% of cases with ethmoidal polypi and in 44.44% ears with an AC polyp preoperatively.

The findings of the present study are compared with the study by Chaudhary et al.<sup>12</sup> They found retraction of drum, suggestive of ET dysfunction in 50% of their cases. However, they have not done postoperative follow-up and have not studied ET function in cases of AC polyp.

Yeolekar and Dasgupta<sup>13</sup>, in their study, found 76.92% improvement in ME disease in the form of dry ear or closure of perforation after polypectomy. Rajati et al<sup>4</sup> studied 42 cases of sinonasal polyposis with 24 healthy control and 24 patients of nasal obstruction without polyp. Type B tympanogram ( $p < 0.025$ ) showed significant difference in 3 groups supporting the present study. The cause of dysfunction in sinonasal polyposis could be because of the mechanical obstruction at pharyngeal end of ET in AC polyp. There can be inflammation due to allergic or infection associated with polyposis leading to ET dysfunction as suggested by Rajati et al.<sup>4</sup>

## CONCLUSION

These data suggest that chronic nasal obstruction due to sinonasal polyposis is the frequent cause of ET dysfunction. Removal of polyp significantly improved tubal function and ME ventilation at least 6 weeks from surgical procedure. Though present study does not have large number of cases, evidence is provided that removal of polyp is valid consideration taking care of ET dysfunction leading to ME disease.

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