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Original Research Article

Symptom-based clinical and tympanometric assessment of Eustachian tube dysfunction

Prerana Dani[1]*, Tanisha Dhanelia[1], Anupam Minj[1], Neha Swarnkar[1], Shailendra Gupta[1], B. R. Singh[2]

[1]Department of ENT, R. S. D. K. S. Government Medical College, Ambikapur, Chhattisgarh, India
[2]R. S. D. K. S. Government Medical College, Ambikapur, Chhattisgarh, India

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***Correspondence:**
Dr. Prerana Dani,
E-mail: prerana.dani07@gmail.com

ABSTRACT

Background: Eustachian tube dysfunction (ETD) is a clinically important disorder that impairs middle-ear ventilation, pressure equalization, and mucociliary clearance. It contributes to otologic symptoms such as ear fullness, hearing impairment, tinnitus, and pain, and may predispose to chronic middle-ear pathology. Despite its practical importance, the burden of ETD in symptomatic outpatient populations remains under-reported, particularly in hospital-based Indian settings. Aim of the study was to evaluate the clinical profile, tympanometric findings, associated factors, and independent predictors of ETD in symptomatic patients attending a tertiary care ENT outpatient department.
Methods: This hospital-based cross-sectional study included 384 symptomatic patients. Clinical history, symptom assessment, ETDQ-7, and tympanometric evaluation were used for assessment. Statistical analysis included descriptive statistics, Chi-square testing, and multivariate logistic regression, with $p<0.05$ considered significant.
Results: ETD was present in 168 of 384 patients (43.8%). The mean age was 28.14±6.80 years, and the largest age group was 21–30 years. Males constituted 60.9% of the study population. Significant symptom associations were observed for aural fullness, hearing loss, tinnitus, and ear pain. Clinical factors significantly associated with ETD included allergic rhinitis, upper respiratory tract infection, chronic sinusitis, deviated nasal septum, smoking, and adenoid hypertrophy, while GERD was not statistically significant. On multivariate analysis, the strongest predictors were type B/C tympanogram (adjusted OR 8.92), hearing loss (adjusted OR 6.48), and aural fullness (adjusted OR 5.12).
Conclusions: ETD is highly prevalent among symptomatic ENT outpatients. Aural fullness and hearing loss are the most useful clinical indicators, while abnormal tympanometry provides the strongest objective support for diagnosis. A combined symptom-based and tympanometric approach is essential for early recognition and appropriate management of ETD in routine practice.

Keywords: Eustachian tube dysfunction, Tympanometry, ETDQ-7, Hearing loss, Aural fullness, Cross-sectional study

INTRODUCTION

The eustachian tube is an anatomically narrow but physiologically critical structure connecting the middle-ear cavity with the nasopharynx. It maintains middle-ear homeostasis through three principal functions: ventilation and pressure equalization, protection from nasopharyngeal reflux and pathogens, and mucociliary clearance of secretions. Failure of these functions results in eustachian tube dysfunction (ETD), a disorder that may manifest as aural fullness, blocked-ear sensation, hearing impairment, tinnitus, pressure disequilibrium, and pain. Prolonged dysfunction may contribute to otitis media with effusion, tympanic membrane retraction, chronic suppurative disease, and long-term hearing-related morbidity.[1]

Historically, ETD was often viewed as secondary to other middle-ear conditions rather than a major clinical entity in its own right. Contemporary work has suggested that ETD is more prevalent than previously assumed according to the setting studied and the diagnostic tools employed. The recognition of ETD as a significant otologic entity is growing, motivated by its potential implications for hearing health, quality of life and middle ear disease burden.[2,3]

This heterogeneity reflects differences in age structure, environmental exposure, referral patterns, and, importantly, the lack of a universal gold-standard diagnostic test.[4]

ETD is also closely related to upper-airway disease. Allergic rhinitis, chronic rhinosinusitis, recurrent upper respiratory tract infection, adenoid hypertrophy, and nasopharyngeal obstruction can impair tubal opening by producing mucosal edema or mechanical blockage near the pharyngeal orifice. Lifestyle and environmental influences such as smoking, dust exposure, pollution, and crowding may further increase vulnerability. In a tertiary care setting, where patients often present after a variable symptom duration and with coexisting nasal or pharyngeal pathology, understanding these associations is particularly important for effective diagnosis and management.[5-7]

In this context, the present study was undertaken to evaluate the prevalence, symptom profile, associated clinical factors, tympanometric findings, and independent predictors of ETD among symptomatic patients attending a tertiary care ENT outpatient department. The study also aimed to present the findings in a manner useful for routine clinical practice, highlighting which symptoms and objective measures most reliably identify patients at risk of ETD.

METHODS

This hospital-based cross-sectional study conducted in the Department of Otorhinolaryngology at Rajmata Shrimati Devendrakumari Singhdeo Government Medical College, Ambikapur, Chhattisgarh over a period of one year (April 2024 toMay 2025). The institution is a tertiary care teaching hospital catering to urban, rural and tribal population from Surguja and surrounding districts.

The study population consisted of patients presenting with ear-related complaints suggestive of ETD or related middle-ear symptoms. The cross-sectional design was selected to assess the clinical and tympanometric profile of ETD at the time of presentation and to explore factors associated with its occurrence in a symptomatic outpatient population. Inclusion criteria included: all sex, age group (18-50) year, retracted tympanic membrane and type B and C tympanogram. Exclusion criteria included: neonate, perforated tympanic membrane, cholesteatoma, and previous surgery of eustachian tube or radiation treatment.

A total of 384 patients were included in the study. Patients were evaluated irrespective of gender and were grouped by age into <20 years, 21–30 years, 31–40 years, and 41–50 years for descriptive analysis. Demographic details, symptom history, and associated ENT complaints were recorded on a structured proforma. Particular attention was paid to the presence of aural fullness, hearing loss, tinnitus, and ear pain, as these symptoms are frequently linked to ETD in clinical practice.

The sample size was calculated using the standard formula, taking a 95% confidence interval, an expected prevalence of 50% and an absolute precision of 5%.

$$n = Z^2pq/d^2$$

This yielded a required sample size of 384. Consecutive eligible patients were included until the desired sample size was achieved. A convenience consecutive sampling approach was considered appropriate for this hospital-based observational study because the main objective was to document the pattern of disease and associated factors among patients presenting for care.

Data were collected using a predesigned and pretested semi-structured proforma. The proforma included patient identification details, age, sex, residence, socioeconomic status, presenting symptoms, duration of disease, side involved, associated nose and throat complaints, relevant personal and environmental history, and treatment history.

In addition to primary otologic symptoms, associated clinical factors were documented, including allergic rhinitis, upper respiratory tract infection (URTI), chronic sinusitis, deviated nasal septum (DNS), smoking, gastroesophageal reflux disease (GERD), and adenoid hypertrophy. These factors were included because of their potential role in producing mucosal inflammation, nasopharyngeal obstruction, or impaired tubal opening. Symptom-based evaluation also included ETDQ-7 scoring for patients undergoing assessment.

All patients underwent tympanometric examination as the principal objective investigation. Tympanograms were classified into type B and type C abnormalities as markers relevant to ETD. Clinical diagnosis was not based on symptoms alone; instead, symptom burden was interpreted with objective tympanometric findings. This combined approach was adopted to improve diagnostic and align with current practical otologic assessment.

Data were entered into Microsoft Excel and analyzed using statistical package for the social sciences (SPSS) version 20.0. Descriptive statistics were used to summarize the study findings. Associations between ETD status and demographic variables, symptoms, and associated clinical factors were tested using chi-square analysis. Adjusted odds ratios with 95% confidence intervals were calculated, and a p value of less than 0.05 was considered statistically significant.

The study was approved by the Institutional Ethics Committee before commencement. Written informed consent was obtained from adult participants and from parents or legal guardians in the case of minors. Confidentiality of all patient data was maintained throughout the study.

RESULTS

A total of 384 symptomatic patients were assessed. ETD was identified in 168 patients (43.8%), while 216 patients (56.2%) did not meet criteria for ETD. The mean age of the study population was 28.14±6.80 years. The age group with the highest representation was 21–30 years (156 patients; 40.6%), followed by 31–40 years (104 patients; 27.1%), 41–50 years (72 patients; 18.8%), and<20 years (52 patients; 13.5%).

When ETD status was compared across age groups, the distribution was remarkably uniform. ETD was present in 44.2% of patients aged<20 years, 43.6% of those aged 21–30 years, 44.2% of those aged 31–40 years, and 43.1% of those aged 41–50 years. Statistical analysis showed no significant association between age and ETD. Males constituted 234 of the 384 patients (60.9%), whereas females constituted 150 (39.1%). A male predominance was therefore observed in the study population, although male gender did not remain significant in the final regression model.

Clinical symptom analysis showed that aural fullness, hearing loss, tinnitus, and ear pain were all significantly associated with ETD. Aural fullness was present in 130 ETD-positive patients compared with 82 ETD-negative patients. Hearing loss was recorded in 120 ETD-positive patients versus 54 ETD-negative patients and showed one of the strongest clinical associations. Tinnitus was present in 118 ETD-positive and 82 ETD-negative patients, while ear pain occurred in 102 ETD-positive and 88 ETD-negative patients. These findings indicate that symptom burden was consistently higher in the ETD-positive group, particularly for aural fullness and hearing loss.

A number of associated clinical conditions also demonstrated significant relationships with ETD. Allergic rhinitis was present in 102 ETD-positive versus 68 ETD-negative patients, upper respiratory tract infection in 94 versus 72, chronic sinusitis in 88 versus 60, deviated nasal septum in 76 versus 64, smoking in 70 versus 58, and adenoid hypertrophy in 84 versus 40. GERD was more common in the ETD-positive group (62 versus 54), but the association was not statistically significant. Among these factors, adenoid hypertrophy showed the strongest association, followed by allergic rhinitis and chronic sinusitis, underlining the importance of upper-airway inflammation and nasopharyngeal obstruction in ETD pathogenesis. Severity analysis demonstrated that mild ETD accounted for 143 patients (37.2%), moderate ETD for 139 (36.2%), and severe ETD for 102 (26.6%). Thus, mild and moderate disease together accounted for 73.4% of the study population, suggesting that most patients presented before advanced chronic disease had developed. The ETDQ-7 mean score was reported as 18.92±7.91 in the ETD-positive group, 21.82±7.37 in the ETD-negative group, and 20.65±7.69 overall. This pattern indicates overlap between the two groups and suggests that symptom scoring should be interpreted with caution and always alongside objective measures.

Multivariate logistic regression demonstrated that the strongest independent predictor of ETD was type B/C tympanogram, with an adjusted odds ratio of 8.92 (95% CI 4.10–19.38). This was followed by hearing loss (adjusted OR 6.48; 95% CI 3.85–10.90), aural fullness (adjusted OR 5.12; 95% CI 3.10–8.45), tinnitus (adjusted OR 2.76; 95% CI 1.70–4.48), and ear pain (adjusted OR 1.98; 95% CI 1.20–3.27). Age and male gender were not statistically significant after adjustment. These findings indicate that objective tympanometric abnormality and a focused symptom profile together provide the most reliable framework for identifying ETD in symptomatic patients.

Table 1: Demographic and prevalence characteristics.

Variables	Number	Percentage
Total patients	384	100
ETD present	168	43.8
ETD absent	216	56.2
Male	234	60.9
Female	150	39.1
Urban	228	59.4
Rural	156	40.6

Table 2: Age distribution and ETD status.

Age group (years)	ETD present	ETD absent	Total	ETD %
<20	23	29	52	44.2
21–30	68	88	156	43.6
31–40	46	58	104	44.2
41–50	31	41	72	43.1
Total	168	216	384	43.8

Table 3: Clinical factors associated with ETD.

Clinical factors	ETD present	ETD absent	Chi-square	P value
Allergic rhinitis	102	68	22.6	<0.001
URTI	94	72	10.8	0.001
Chronic sinusitis	88	60	14.2	<0.001
DNS	76	64	4.32	0.038
Smoking	70	58	3.85	0.050
GERD	62	54	2.94	0.086
Adenoid hypertrophy	84	40	28.7	<0.001

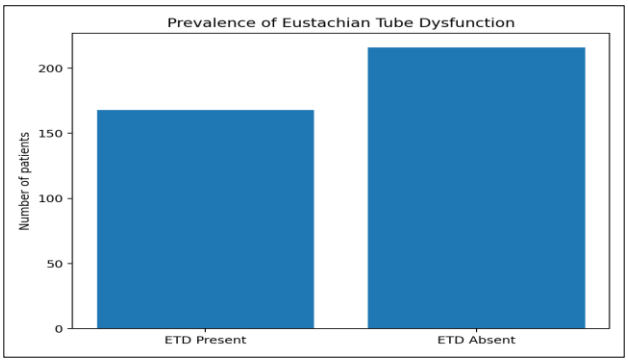

Figure 1: Prevalence of eustachian tube dysfunction in the study population.

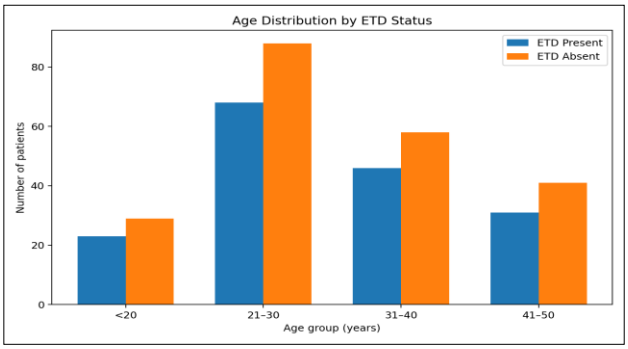

Figure 2: Age distribution by ETD status.

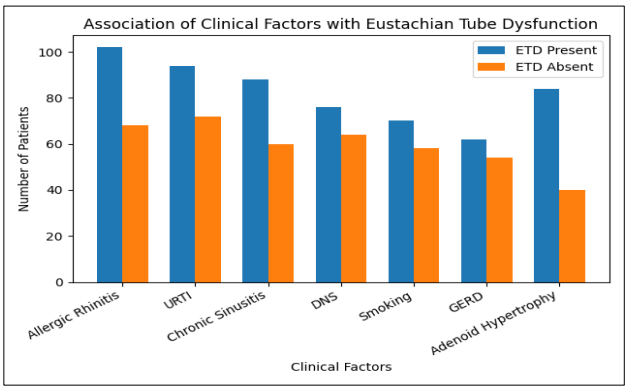

Figure 3: Association of clinical factors with eustachian tube dysfunction.

Table 4: Independent predictors of ETD on multivariate regression.

Variables	Adjusted OR	95% CI	P value
Age (years)	0.97	0.93–1.01	0.182
Male gender	1.42	0.89–2.26	0.138
Aural fullness	5.12	3.10–8.45	<0.001
Hearing loss	6.48	3.85–10.90	<0.001
Tinnitus	2.76	1.70–4.48	<0.001
Ear pain	1.98	1.20–3.27	0.007
Type B/C tympanogram	8.92	4.10–19.38	<0.001

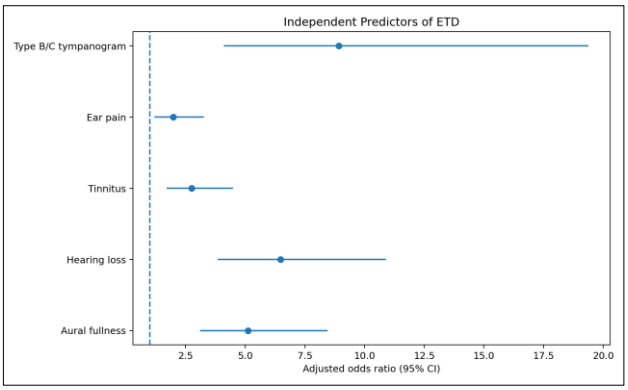

Figure 4: Independent predictors of ETD (forest plot).

DISCUSSION

The present study demonstrates that ETD is highly prevalent among symptomatic patients attending a tertiary care ENT outpatient department, affecting 43.8% of the study population. This prevalence is substantial and aligns more closely with symptom-based or upper-airway-associated cohorts than with low-prevalence community or elderly population studies. The high prevalence in the present series is likely due to the hospital-based and symptomatic nature of the population, where individuals are already enriched for otologic complaints and inflammatory upper-airway disorders.[8]

The age profile of the present study showed clustering in young adults, especially in the 21–30-year group, but the proportion of ETD remained almost constant across age bands. This finding suggests that within a symptomatic outpatient population, age alone is not a dominant determinant of ETD. Although pediatric literature traditionally emphasizes anatomical predisposition in children because of a shorter and more horizontal tube, the present findings indicate that, in a predominantly adult ENT clinic population, inflammatory and environmental influences may outweigh age-linked structural differences.[9,10]

A male predominance was observed in the overall cohort, but gender did not remain significant after multivariate adjustment. This implies that sex-related differences in raw prevalence may reflect referral patterns, environmental exposures, smoking habits, occupational dust exposure, or healthcare utilization rather than intrinsic biological susceptibility. The strong representation of rural patients in the sample further supports the possibility that environmental and access-related influences may shape who presents with symptomatic ETD in tertiary care practice.[9,11,12]

The symptom profile observed in the present study is clinically important. Aural fullness and hearing loss emerged as the strongest symptomatic indicators of ETD, followed by tinnitus and ear pain. Aural fullness reflects failure of pressure equalization and altered middle-ear

mechanics, while hearing loss likely reflects reduced tympanic membrane mobility and disturbed sound transmission due to negative pressure or middle-ear dysfunction. Tinnitus and ear pain, although less specific, strengthen clinical suspicion when present in combination with ear blockage or muffled hearing.[2,14]

The associated-factor analysis adds further value to the study. Significant links with allergic rhinitis, chronic sinusitis, URTI, and adenoid hypertrophy strongly support the concept that ETD is closely connected with upper-airway inflammation and nasopharyngeal pathology. Adenoid hypertrophy showed the strongest association among the clinical factors examined, suggesting that mechanical obstruction near the pharyngeal orifice of the Eustachian tube may play a major role in symptomatic patients. The significance of smoking and DNS, though less strong, suggests that both mucosal irritation and altered nasal airflow may contribute to dysfunction. GERD showed a numerical trend but not statistical significance in the present sample.[2,12]

The most decisive finding of the present study is the importance of tympanometric abnormality. Type B/C tympanogram emerged as the strongest independent predictor of ETD, with an adjusted odds ratio higher than any symptom variable. This underlines the central role of objective assessment in ETD diagnosis. Symptoms are essential for suspicion, but tympanometry provides the most convincing outpatient evidence of impaired middle-ear ventilation and pressure dysregulation. In practical terms, this means that symptomatic screening without tympanometric confirmation risks both overdiagnosis and underdiagnosis.[14,15]

Another notable observation is that most patients had mild to moderate disease. This indicates that a large proportion of ETD in clinical practice can potentially be identified before progression to more advanced middle-ear pathology such as chronic retraction, effusion, or persistent conductive hearing impairment. Early diagnosis therefore has preventive importance. Patients with nasal allergy, sinus disease, adenoidal pathology, or recurrent URTI who report ear blockage or hearing fluctuation merit particularly careful evaluation.[12,14]

The ETDQ-7 findings in the present dataset showed overlap between groups, and the mean score was paradoxically higher in the ETD-negative group. This pattern suggests that symptom questionnaires should be interpreted cautiously and should not be considered a substitute for objective testing. In day-to-day practice, ETDQ-7 remains useful for capturing symptom burden and for follow-up, but its diagnostic value is greatest when paired with tympanometric and otoscopic findings.[2]

Overall, the study supports a clinically practical message: ETD is common in symptomatic ENT patients; aural fullness and hearing loss are especially informative symptoms; associated upper-airway disease is highly relevant; and tympanometry provides the strongest objective support for diagnosis. A structured symptom-based and tympanometric strategy is therefore well justified for routine outpatient assessment.

Limitations

The study was hospital-based and may therefore over-represent symptomatic, chronic, or severe cases compared with the general community. Convenience consecutive sampling may have introduced selection bias. The cross-sectional design allows identification of association but not definitive causal inference. Some behavioural and environmental exposures were based on patient or caregiver recall and may be subject to recall bias. The study was conducted at a single tertiary care institution, which may limit generalizability to other settings.

CONCLUSION

The present study concludes that ETD is highly prevalent in symptomatic ENT outpatients and condition affected nearly 44% of the symptomatic population. Aural fullness and hearing loss were the most useful clinical indicators of ETD, while abnormal tympanometry, especially type B/C patterns, provided the strongest objective support for diagnosis. Upper-airway inflammatory conditions and nasopharyngeal pathology, particularly allergic rhinitis, chronic sinusitis, URTI, and adenoid hypertrophy, showed significant association with ETD, emphasizing the need for integrated ENT evaluation. Most patients had mild to moderate disease, indicating an opportunity for early diagnosis and timely intervention before the development of chronic middle-ear sequelae. A combined symptom-based and tympanometric approach should be adopted as the preferred strategy for routine evaluation and early management of ETD in symptomatic patients.

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REFERENCES

1. Hamrang-Yousefi S, Ng J, Andaloro C. Eustachian tube dysfunction. In: StatPearls. Treasure Island (FL): StatPearls Publishing; 2023.
2. Schilder AGM, Bhutta MF, Butler CC, Holy C, Levine LH, Kvaerner KJ, et al. Eustachian tube dysfunction: consensus statement on definition, types, clinical presentation and diagnosis. Clin Otolaryngol. 2015;40(5):407-11.
3. Kim AS, Betz JF, Goman AM, Poe DS, Reed NS, Ward BK, et al. Prevalence and Population Estimates of Obstructive Eustachian Tube Dysfunction in US Adolescents. JAMA Otolaryngol Head Neck Surg. 2020;146(8):763-5.
4. Dorney I, Otteson T, Kaelber DC. Epidemiology of Eustachian tube dysfunction and related otologic

diagnoses among children with achondroplasia. Int J Pediatr Otorhinolaryngol. 2022;163:111339.
5. Smith ME, Tysome JR. Tests of Eustachian tube function: a review. Clin Otolaryngol. 2015;40(4):300-11.
6. Norman G, Llewellyn A, Harden M, Coatesworth A, Kimberling D, Schilder AGM, et al. Systematic review of the limited evidence base for treatments of Eustachian tube dysfunction:a health technology assessment. Health Technol Assess. 2014;18(46):1-180.
7. Gey A, Reiber J, Honigmann R, Zirkler J, Rahne T, Plontke SK. The Rate of Eustachian Tube Dysfunction in Adult Patients With Chronic Inflammatory Middle Ear Disease Is Low. Otol Neurotol. 2023;44(5):e305-10.
8. Alshehri A, Bukhari LK, Almasswary SA, Alotaibi SM, AlQahatani RY, Althumairy HA, et al. Prevalence of Eustachian tube dysfunction and its associated factors among the general public in Aseer Region, Saudi Arabia. Middle East J Fam Med. 2024;7:31.
9. Vila PM, Thomas T, Liu C, Poe D, Shin JJ. The burden and epidemiology of Eustachian tube dysfunction in adults. Otolaryngol Head Neck Surg. 2017;156(2):278-84.
10. Alhossaini Altalhi WA, Alsulaimani AI, Alhossaini ZA, Alharthi RM, Almalki ZA, Altalhi WA, et al. Prevalence of and factors associated with Eustachian tube dysfunction among the public in Taif, Saudi Arabia. Cureus. 2022;14(7).
11. Alshehri K, Saggaf O, Alshamrani H, Alnefaie A, Alghamdi K. Prevalence of and Factors Associated With Eustachian Tube Dysfunction Among the Public in Jeddah, Saudi Arabia: Cross-Sectional Survey-Based Study Interact J Med Res. 2020;9(4):e14640.
12. Fischer JL, Riley CA, Hsieh MC, Marino MJ, Wu XC, McCoul ED. Prevalence of Eustachian tube dysfunction in the US elderly population. Otolaryngol Head Neck Surg. 2020;163(6):1169-77.
13. McCoul ED, Anand VK, Christos PJ. Validating the clinical assessment of Eustachian tube dysfunction: The ETDQ-7. Laryngoscope. 2012;122(5):1137-41.
14. Tangbumrungtham N, Patel VS, Thamboo A, Patel ZM, Nayak JV, Ma Y, et al. The prevalence of Eustachian tube dysfunction symptoms in patients with chronic rhinosinusitis. Int Forum Allergy Rhinol. 2018;8(5).
15. Smith ME, Tysome JR. Tests of Eustachian tube function: a review. Clin Otolaryngol. 2015;40(4):300-11.

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