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Original Research

Noise Induced Hearing Loss in Indian Railway Loco Pilots: Are We Aware?

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ABSTRACT

Background

Rail engine drivers are known as loco pilots. Rail engines produce noise of around 100 dB. Loco pilots are continuously exposed to such loud noise as a result of their occupation. Hence, hearing ability is at jeopardy due to their occupation.

Objective

To assess noise induced hearing loss in Indian loco pilots by pure tone audiometry (PTA).

Methods

A cross sectional study which included 30 loco pilots and 50 control subjects. All were between 40-50 years. Hearing assessment was done by PTA after fulfilling inclusion and exclusion criteria. All the data was statically analyzed using SPSS software version 21. The level of significance $p < 0.05$ was considered as significant.

Results

The mean age of loco pilots was 44.6 ± 2.9 years (Mean \pm 2SD) and of control was 42.8 ± 2.1 years (Mean \pm 2SD). The mean pure tone average in loco pilots was 31.5 ± 5.5 dB in right ear and 30.5 ± 6.8 dB in left ear. Thus, loco pilot group was having mild hearing impairment. On comparing both ears threshold in the groups, the difference was statically significant (p value < 0.01) and Pearson correlation was > 0.9 .

Conclusion

Our study shows mild hearing impairment in loco pilots. There is positive correlation between hearing loss and occupation. They are at more risk of hearing loss as compared to normal population attributable to their occupation. Safeguarding their hearing ability is a challenge.

Keywords

Train drivers; Loco pilots; Noise Induced Hearing Loss (NIHL); Pure Tone Audiometry (PTA); Audiometric Notch.

INTRODUCTION

Noise is acoustically formed up of several sound waves with anarchically distributed amplitude and phase ratios leading to an unpleasant sensation.¹ Constant exposure to loud noise results in outer hair cell damage, chiefly the basal turn of cochlea.² Worldwide, 16% of the disabling hearing loss in adults is attributable to occupational noise ranging from 7% to 21%.³ Noise Induced Hearing

Loss (NIHL) is defined as partial or complete hearing in one or both ears as the result of employment. Various studies have been performed for occupational noise over textile, printing, mining etc. Indian railways are considered to be the transport lifeline of India. Loco pilots are the individuals who run these engines. These engines are notorious for their loud noise. Loco pilots are continuously exposed to such loud noise daily for many years.⁴ There lacks studies in India which unleashes the occupational noise hazards

among railway loco pilots. The aim of current study is to assess the NIHL in railway loco pilots by Pure Tone Audiometry (PTA).

MATERIAL AND METHODS

Present research was a cross sectional study which involved 30 loco pilots. It was conducted near railway station for the ease of loco pilots. Following criteria was used for study.

Inclusion criteria:

1. Loco pilot age should be between 40-50 years.
2. Tympanic membranes were normal on examination.
3. Minimum 10 years of active service experience.

Exclusion Criteria:

1. History of ear discharge or ear surgery.
2. Should not have used any ear protection while driving engine.
3. Subjects suffering from any systemic illness e.g. diabetes mellitus, hypertension.
4. Subjects that were not giving consent.

The subjects were informed about the study and consent was obtained. Study was conducted at a well equipped audiology centre near railway station. It was done for convenience of loco pilots as to least effect their resting hours. Complete history was taken and thorough otolaryngology examination was being done. PTA was performed after 6 hours of rest following journey in order to obtain best possible audiological thresholds and omit confounding factors. All subjects were assessed by single trained audiologist in a double chamber audiometry room fulfilling ANSI (American National Standard Institution) 1999 guidelines. Subjects underwent PTA by modified Hughson Westlake method.⁵ It was performed by Hortmann Audiometer PA444 audiometer. Air and bone conduction thresholds were recorded from the frequency of 500 to 8000 Hz for both the ears and wherever necessary masking was done. Pure tone average is taken as average of pure tone thresholds at 500, 1000, 2000 and 4000 Hz frequency.⁶

Although, we were not having any baseline audiogram but loco pilots undergo strict medical examination while joining railway services. Moreover, they undergo periodic medical examination at regular interval as per railway policy.⁷ So, we considered them to be having normal hearing thresholds while joining railway services.

For the control population, we selected 50 random patients from otolaryngology OPD of a tertiary care hospital. These subjects presented with other than ear problems. The subjects were excluded if they were involved in noisy occupation. They all were selected between 40-50 years of age to avoid age as confounding factor. They were also assessed by PTA under similar conditions.

All the data was compiled and statically analyzed using Statistical Package for Social Sciences (SPSS) software version 21. Univariate and bivariate analysis was carried using student t test. Chi square test was used for categorical variables. The data repre-

sented in study is represented as mean±standard deviation (SD). The level of significance $p < 0.05$ was considered as significant.

RESULTS

There were 30 loco pilots included in study. All subjects were male and between 40-50 years. This age group was taken as they were having enough driving experience and were below expected presbycusis age group. The mean age of subjects was 44.6 ± 2.9 years (Mean±2 SD). All were having driving experience for more than 10 years. They were having average experience of 16.8 ± 2.4 years. The pure tone thresholds of this group are stated in table -1.

Table 1. Pure Tone Thresholds in Loco Pilot Group

Frequency (Hz)	Thresholds in right ear (dB) Mean±SD	Thresholds in left ear (dB) Mean±SD
500	26±4.6	24±4.2
1000	28±5.6	26±6.8
1500	32±4.7	35±4.2
2000	34±6.8	33±4.7
4000	38±5.8	39±7.1
6000	44±10.1	42±9.2
8000	49±8.6	47±7.9

There were 50 subjects in control group. All were male between 40-50 years of age and were having normal ear examination. All subjects were not involved in noisy occupation. The mean age of subjects was 42.8 ± 2.1 years (Mean±2 SD). The pure tone thresholds of this group are stated in table -2.

Table 2. Pure Tone Thresholds in Control Group

Frequency (Hz)	Thresholds in right ear (dB) Mean±SD	Thresholds in left ear (dB) Mean±SD
500	10±2.8	9±2.1
1000	12±3.8	11±1.8
1500	12±2.6	13±2.9
2000	13±3.4	12±2.8
4000	14±2.9	15±2.1
6000	16±3.2	15±3.4
8000	15±2.1	16±2.5

The mean pure tone average in control group was 12.3 ± 1.7 dB in right ear and 11.8 ± 2.5 dB in left ear. Whereas mean pure tone average in loco pilots was 31.5 ± 5.5 dB in right ear and 30.5 ± 6.8 dB in left ear. As per the criteria stated by WHO for hearing impairment in table -3, the loco pilot group was having mild hearing impairment.⁸ However, the changes at 6000 Hz and 8000 Hz were quite significant from rest of the frequencies.

Table 3. WHO Criteria for Hearing Impairment

Pure Tone Average(dB)	Degree of Hearing Impairment
0-25	Not Significant
26-40	Mild
41-55	Moderate
56-70	Moderately Severe
71-90	Severe
>91	Profound

Audiometric notch is defined as a sudden dip followed up by sudden rise of hearing thresholds at a particular frequency. In our study, audiogram of sixteen subjects showed audiometric notch two being at 2 kHz, six at 4 kHz and eight at 6 kHz.

The data of each ear was compared in both the groups. On comparing the right ear thresholds in both the groups, the difference was statically significant (p value < 0.01) and Pearson correlation was 0.920. Similarly, on comparing the left ear thresholds in both the groups, the difference was statically significant (p value < 0.01) and Pearson correlation was 0.972. Therefore, Pearson correlation implies positive correlation between noise exposure and hearing loss in loco pilot group.

DISCUSSION

Railways are said to be the transport lifeline of India. Loco pilots are the individuals who are running this lifeline. There are approximately 82000 sanctioned posts of loco pilots in Indian railways as per 2012 data.⁷ This involves a huge section of qualified people involved in the occupation. There is noise level of approximately 100 dB in railway engines.⁷ There lacks studies over train drivers occupational hazard in India. However, research has been carried out in western countries.

Continuous noise of 100 dB can lead to significant hearing impairment. Study conducted in a pharmaceutical company which had noise exposure of 100-105 dB found significant NIHL amongst workers.⁹ National Institute of Miner's Health carried out studies over mines and found prevalence of 12.8% hearing loss amongst employees.¹⁰ In our study, we found mild hearing impairment in loco pilots due to continuous exposure of 100 dB noise in engines.

Lie A et al conducted a study over hearing status in Norwegian train drivers and conductors and found that there were no significant hearing loss in test group as compared to control group.¹¹ Study conducted by Clark WW et al also showed no significant hazardous noise exposure.¹² In our study, we found mild hearing impairment in loco pilots and significant hearing impairment as compared to control group. This may be attributable to the fact that Norway railway engines produce noise of 70-80 dB which is lower as compared to Indian engines which produce 100 dB noise.

Moreover, Indian railways have not worked upon noise and vibration reduction in engines. Most of the Norway drivers are not having a hectic schedule for duties. Whereas, loco pilots in India are overburdened with 10 hours duty at a stretch followed by a rest of 12 hours six days a week.⁷

Waghmare S et al conducted a cross sectional study over 60 loco pilots for evaluating NIHL.¹³ They used Brain Stem Evoked Response Audiometry (BERA) as a tool for assessment. They found mild to profound sensorineural hearing loss in loco pilots which were directly proportional to their service tenure. This study has many similarities with our study. First, both studies are from India. Therefore, working conditions and noise exposure are almost similar. Second, the sample chosen in both the studies were having similar age group and a minimum experience of 10 years. Third, both studies demonstrate hearing loss in loco pilots. However, BERA was the tool used by the Waghmare S et al. BERA is an objective tool for hearing assessment but it does not depict the actual hearing loss at a particular frequency. PTA was used as an assessment tool in our study because it is the best and cheapest tool which can accurately assess hearing loss by subjective method.

In our study, audiogram of sixteen subjects showed audiometric notch two being at 2 kHz, six at 4 kHz and eight at 6 kHz. Conventionally, it has been described at 4 kHz.¹⁴ However, recent studies have come up with different observations. Our observation is also favoured by Nair S et al study.¹⁵ They performed audiometric analysis of Indian Air Force (IAF) personnel at an operational IAF base. A large proportion of personnel presented with audiometric notch at 6 kHz (57.3%) as compared to 4 kHz (34.3%)

Therefore, present study shows mild hearing impairment in loco pilots as an occupational hazard and a significant hearing loss as compared to control population. Moreover, our study depicts strong positive correlation between their occupation and hearing loss. Extensive research has been done over aviation industry which involves less number of employees as compared to railways. Study over railway employees is the need of the hour as it involves a huge population and is Indian transport lifeline. The sample size of this study is small and it cannot be generalized for whole Indian railways. NIHL amongst loco pilots merits an extensive research as our study might be tip of iceberg. Further, research can be carried out over large sample group and possibility of NIHL prevention amongst them.

CONCLUSION

Noise is hazardous industrial pollutant leading to hearing loss in loco pilots. Our study shows mild impairment in loco pilots whose working experience was more than 10 years. There is positive correlation between hearing loss and occupation. They are at more risk of hearing loss as compared to normal population attributable to their occupation. Audiometric notch is commonly seen at 4 kHz and 6 kHz in loco pilots. Safeguarding their hearing ability is a challenge.

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Case Report

Nasal Manifestations in Granulomatosis with Polyangiitis: A Case Report and Review of the Literature

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ABSTRACT

Granulomatosis with polyangiitis (GPA) is an anti-neutrophil cytoplasmic antibody (ANCA)-associated vasculitides of medium and small arteries, characterized by necrotizing granulomatous inflammation of the upper and lower respiratory tract with coexisting glomerulonephritis. We report a case of GPA in a patient presenting with a six-month history of spontaneous epistaxis, nasal obstruction and frontal headache. Nasal endoscopy showed a large nasal septum perforation and an anterior translucent mass in the right nasal fossa. Findings were confirmed by computed tomography (CT) scan with contrast. The patient underwent functional transnasal endoscopic removal of the mass; histological examination showed tissue features suggestive of GPA; dosage of c-ANCA e p-ANCA antibodies confirmed GPA diagnosis. Nasal septum perforation has long been recognized as a feature of GPA, in which granulomatous destruction of nasal cartilage can result in perforation and saddle-nose deformity. Prompt diagnosis of GPA is important to initiate therapy which may be life-saving and organ sparing.

Keywords

Granulomatosis with polyangiitis; Nasal septum perforation; Nasal polyp; Vasculitis.

INTRODUCTION

Granulomatosis with polyangiitis (GPA), previously known as Wegener granulomatosis, is an anti-neutrophil cytoplasmic antibodies (ANCA)-associated vasculitides of medium and small arteries, characterized by necrotizing granulomatous inflammation of the upper (ear, nose, throat) and lower (lung) respiratory tract with coexisting glomerulonephritis (renal systems). Untreated generalized GPA is a serious disease that may lead to an irreversible organ damage as renal or lung failure.¹⁻³ The estimated incidence of GPA in Europe is 5-10 cases per 1 million population.⁴

The disease is equally distributed between males and females and affects people at any age, but the most common age of presentation of GPA is the sixth and seventh decade of life. In 80-95% of the patient, the presenting symptoms of GPA are otorhinolaryngological manifestations.⁵

We report a case of GPA in a patient presenting with a six-month history of spontaneous epistaxis, nasal obstruction and frontal headache and evidence at physical examination of a polypoid mass in the nasal fossae and an asymptomatic perforation of the nasal septum.

CASE REPORT

A 38-year-old women presented to the Otolaryngology Department of our University reporting a six-month history of spontaneous epistaxis, nasal obstruction and frontal headache. Otolaryngologic physical examination through nasal endoscopy showed an anterior perforation of the nasal septum and a polypoid translucent mass in the anterior right nasal cavity. The patient reported to habitually smoke 20 cigarettes/die for 20-years and denied previous nasal surgery, nasal trauma, chronic use of nasal decongestants, and assumption of cocaine.

The patient performed maxillofacial computed tomography (CT) scan with contrast that confirmed the presence of a soft density polypoid mass occupying the anterior portion of right nasal fossa associated with cartilaginous nasal septum perforation (Figure 1). General laboratory exams were within normal range. Inflammatory marker assays for C-reactive protein and erythrocyte sedimentation rate were within normal limits. In the clinical suspicion of a malignant condition, the patient

patient was sent to the Immunologic Department of our hospital. No signs of recurrence of the diseases were observed one year after surgery.

DISCUSSION

Granulomatosis with polyangiitis (GPA), previously known as Wegener granulomatosis, is an idiopathic vasculitis involving medium and small arteries.

Among patients with GPA, 80%-95% of patients develop head and neck manifestations during their life⁵ and often otorhinolaryngological symptoms are the presenting and sole signs of the disease.

In case of a GPA developing only in Head and Neck region, this condition is called “*limited GPA*”, differing from more advanced form, named “*generalized GPA*”, characterized by systemic vasculitis with renal and/or pulmonary involvement and systemic symptoms such as fever and asthenia. “*Limited GPA*” phenotype is more likely to affect young female patients, with a recurrent behavior and often non-compliant to medical therapy.⁶ Nasal involvement has long been recognized as a feature of “*Limited GPA*” and usually starts in the septum area supplied by Kiesselbach plexus and then spreads to the paranasal sinuses.⁷

In our case, patient’s symptoms are related to sinonasal region, without systemic involvement. Nasal endoscopy revealed a large nasal septum perforation and an anterior translucent mass in the right nasal fossa. Presence of a translucent mass in the middle meatus is often related to an inflammatory disease like nasal polyps, although concomitant presence of a nasal septum perforation (NSP) is unusual.

In case of a NPS is essential the exclusion of cocaine previous use, due to the possibility of an induced destruction of nasal septum.⁸

NPS has long been recognized as a common feature of autoimmune disorders. As in our case, granulomatous destruction of nasal cartilage can result in nasal septum perforation and may develop in advanced stages to a saddle-nose deformity.^{9,10} A recent systematic review of the existing literature from Guntupalli et al found that GPA and relapsing polychondritis are the autoimmune disorders most frequently related with nasal septum perforation and comprises nearly 80% of the reported cases of autoimmune-related nasal septum perforation cases in the literature (Figure 2).¹¹

Proper and early diagnosis of GPA is essential for imminent therapy implementation and allows avoiding irreversible organ damage.⁵ Diagnosis of GPA may be challenging given various clinical manifestations, and may be difficult to distinguish from neoplastic, infectious and inflammatory etiologies.^{2,12} Differential diagnosis must be done with malignant conditions as Natural Killer T-cell lymphoma; infectious disease such as tuberculosis, aspergillosis and leishmaniasis and inflammatory conditions as sarcoidosis.

Figure 1: Axial Computed Tomography (CT) Scan without Contrast Showing a Soft Density Polypoid Mass Occupying the Anterior Portion of Right Nasal Fossa, Associated with Cartilaginous Nasal Septum Perforation. The Tissue Arises from the Cartilagineal Portion of Nasal Septum and is in Contact with the Lateral Wall of the Nose. Minimal Signs of Body Erosion are Present. Around Structure and Maxillary Sinus are Not Involved.

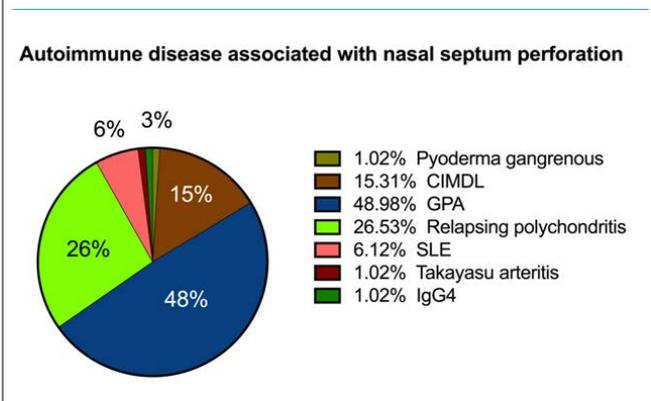


Underwent a trans-nasal endoscopic excision of the mass under general anesthesia. Histological examination showed mixed inflammatory cells T-lymphocytes (CD3⁺, CD56⁺), histiocytes (CD68R⁺) and granulocytes associated to fibrin necrotic material and vascular structures with elastic lamina fragmentation and lumen obliteration. Due to the histological suspicion of a vasculitides, Dosage of c-ANCA e p-ANCA antibodies revealed the presence of GPA (the complete immunological tests are reported in Table 1). The post-operative course was uneventful, and the

Table 1. Patient's Blood Test

	Patient value	Normal range
White blood cell (×10 ³ /mm ³)	8,46	4,40-11,3
Platelet (×10 ³ /mm ³)	306	150-450
Haemoglobin (g/dL)	14	12,5-15,5
Prothrombin time (INR)	0,93	0,80-1,20
c-ANCA (U)	55,80	<20
p-ANCA (U)	<3,20	<20
VES (mm/h)	4,0	<35
PRC (mg/L)	3	0-5
ENA (U)	<0,50	<20

Figure 2: Percentage of Reported Cases of Each Autoimmune Disease Associated with a Nasal Septum Perforation. GPA = granulomatosis with polyangiitis; CIMDL = cocaine-induced midline destructive lesion; SLE = systemic lupus erythematosus; IgG4 = immunoglobulin G4. Re-edited from Guntupalli L. et al.¹¹



Currently in clinical practice diagnosis is usually based on presence of distinctive ANCA and biopsy of affected organ.¹³ In the clinical suspicion of GPA, ANCA testing is essential for GPA diagnosis. c-ANCA (cytoplasmic anti-neutrophil cytoplasmic antibody) are quite specific for GPA, while p-ANCA (peri-nuclear-anti-neutrophil cytoplasmic antibody) may be associated with other autoimmune conditions like inflammatory bowel disease, rheumatoid arthritis, autoimmune liver disease. During active phases of the disease, the sensitivity and specificity of testing for c-ANCA are 91% and 99%, respectively.¹⁴ In the generalized GPA, ANCA are elevated in 90%-95% of patients, whereas in the limited stage of GPA in the ear-nose-throat region, positive levels of c-ANCA may occur in only 46%-70% of patients.¹⁵ Cytoplasmic localization of ANCA (c-ANCA) is 90-95% sensitive in acute generalized GPA

and 60% sensitive in early or localized disease.¹⁶

Biopsy is usually performed when ANCA testing is non-diagnostic or uncertain. Moreover in “limited GPA”, the role of the biopsy increases, because predictive value of c-ANCA is lower.¹³ Histological finding of GPA is characterized by specific abnormalities, such as vasculitis, granulomas, giant cells and necrosis. The sensitivity and specificity of tissue biopsy varies depending on the site of active disease. In patients with nasal involvement, nasal biopsy should be considered early in the evaluation, although an high rate of false negative is reported, comparing with biopsy at other affected sites, thus repeated nasal biopsies are often required.

Although nasal manifestations are quite specific for GPA in head and neck, the occurrence of GPA in other head and neck sites is not unusual. Audiovestibular symptoms are often underestimated, and may occur in 8% to 65% of patients with GPA.¹⁷ Typically auditory symptoms are characterized by sensorineural hearing-loss,¹⁸ although conductive hearing loss may also occur in cases of GPA involving the middle ear or Eustachian tube dysfunction.¹⁷ Audiometric patterns of GPA are typically flat and may coexist with age-related high-frequency loss. Moreover sudden sensorineural hearing loss may also be a presenting symptom of GPA and hearing loss is often a marker of a worsening of disease that may address to a specific treatment.¹⁷ (Other Head and Neck subsites may be involved in GPA, a summary of most common feature is reported in Table 2).

Awareness of this condition is essential for clinical otorhinolaryngologist, considering the various clinical manifestations of GPA and a prompt diagnosis is essential to initiate specific therapy and avoid renal or lung failure.¹⁹

H&N subsite	Frequency	Symptoms
Nose and sinuses	Frequent (>85%)	Nasal obstruction and discharge. Reduction of smell, cacosmia, epiphora. Perforations of nasal septum with “saddle nose” deformity.
Ear	Frequent (19%-61%)	Frequent: Otitis media secondary to Eustachian Tube dysfunction Sensorineural hearing loss in 5%-31% of GPA patients. Rare: Sudden sensorineural hearing loss, vertigo, chronic mastoiditis facial paralysis secondary to bone destruction. External ear manifestations as erythematous or ulcerated lesions.
Salivary glands	rare	Parotid or submandibular glands may be swollen and sore.
Larynx	rare	Subglottic stenosis in childhood. Larynx ulcers.
Oral cavity	rare	<20

CONCLUSION

GPA is an anti-neutrophil cytoplasmic antibodies (ANCA)-associated vasculitides of medium and small arteries. GPA may present with an isolated nasal involvement. Immunological disorders like GPA should be suspected in patients presenting nasal septum perforation without history of other possible causes of nasal perforation, such as previous cocaine use or nasal surgery. Serological exams and histological features are essential to confirm GPA

diagnosis, especially in a case of a “limited GPA”. Prompt diagnosis of GPA is important to initiate specific therapy which may be life-saving and organ sparing.

CONSENT

The patient provided written informed consent for the publication of any associated data and accompanying images.

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The authors declare that they have no conflicts of interest.

CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

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