



A Prospective Study on Post Covid Sudden Onset Sensory Neural Hearing Loss and Its Recovery

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Abstract Sudden sensorineural hearing loss (SSNHL) is a known complication of a number of viral infections, but there is little literature to date on its association to Corona virus disease 2019(COVID-19). This study aimed to investigate the incidence and recovery from SSNHL in post COVID-19 patients. A study was conducted in 6 months of duration at our tertiary care COVID dedicated hospital. Total 280 patients with age group of 12–70 years, laboratory confirmed COVID 19 positive patients having mild to moderate COVID symptoms were included. Patients were examined clinically along with all safety measures to analyze incidence and their recoveries from SSNHL by clinical examination and using Pure Tone Audiometry (PTA). Out of 280 patients the incidence of only SSNHL is 1.07% (3 patients) and SSNHL with tinnitus is 2.14%(6 patients). Total recovery(TR) regained in 2 patients of SSNHL, Partial recovery(PR) in 4 patients, Slight improvement(SI) in 1 patient and no recovery(NR) in 2 patients. The incidence of SSNHL in time of COVID 19 pandemic appears to be higher (3.2%) than before the pandemic (0.005%-0.16%). Incidence among younger age group and patients with no comorbidities has been also increased. In diagnosed case of SSNHL, early treatment with short term course of oral steroids and neuromodulator drugs are the mainstay treatment. Awareness of such non-specific presentation of COVID 19 patients is crucial and shared decision making with the patient and providing health care personnel is necessary for decreasing the hearing loss associated morbidity.

Keywords COVID 19 · Sudden onset sensory-neural hearing loss · Incidence · Recovery

Introduction

Coronavirus disease 2019 (COVID-19) is caused by the severe acute respiratory syndrome corona virus 2 (SARS-CoV-2), a newly emergent corona virus, that was first recognized in Wuhan, Hubei province, China, back in December 2019. Since the first documented case of pneumonia of unknown origin, the novel SARS-CoV-2 leading to COVID-19 has swept across the globe afflicted the people in every corner [1].

A heterogeneous spectrum of clinical manifestations of SARS-CoV-2 viral infection is ranging from asymptomatic to severe disease with multiple organ failure, it is of utmost importance. Apart from the overall presentation being fever, myalgia and lower respiratory tract symptoms of cough and dyspnea, extra pulmonary symptomatology of COVID-19 manifested through a variety of ear, nose, throat (ENT) complaints have been gradually recognized [2].

Sudden Sensory-neural Hearing Loss (SSNHL) is defined as a hearing loss (HL) greater than 30 dB, over at least 3 contiguous audiometric frequencies, occurring suddenly or within 3 days. The cause of SSNHL remains unknown in most patients. Although several etiological hypotheses have been proposed, the most likely causative sources seem to be cochlear injury from impaired vascular perfusion or viral infection [3, 4].

It is relatively common pathology seen in otorhinolaryngology, with a worldwide incidence of 5–160 cases per 100000 people annually [0.005–0.16%] [5].

During the previous SARS epidemic, coronavirus infections were reported to be associated with loss of smell and taste due to neural injury [5].

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Intranasal delivery of SARS-CoV-2 has shown neuro-invasion and encephalitis in mice. Even if there is raising trend of otoneurological involvement of SARS-CoV-2, such as balance disorders, tinnitus, smell, taste disorders and HL in COVID-19 patients has still been marginally studied [3].

Aims and Purpose

To study the incidence of Sudden sensory-neural hearing loss in patients with laboratory confirmed COVID-19 infections.

To observe the recovery rates from SSNHL with laboratory confirmed COVID 19 infections.

Methods and Materials

Study design- Observational prospective study.

Study duration- 06 months.

Sample size- As it was a time bound study. So, total number of patients fulfilling inclusion criteria were included during study duration. (280 patients).

Sampling method- Convenient sampling.

Inclusion Criteria

1. Patients with laboratory affirmed COVID 19 infection using Reverse transcriptase polymerase chain reaction (RT-PCR).
2. Age group between 12 and 70 years.
3. Patients clinically stable and having mild to moderate symptoms, according to NIH guidelines.
4. Compliance with the therapy and adherence to the follow up.

Exclusion Criteria

1. Age < 12 & > 70 years old.
2. Patients with past information regard history of HL and /or tinnitus.
3. Previous ear pathology and /or otologic surgery.
4. Cerebello-pontine angle pathology or congenital ear malformations.
5. Use of ototoxic drugs.
6. Head and /or neck trauma or barotrauma within the last 3 months.
7. Those who lost to follow up (not responding to 3 telephonic calls).

In this study, total 280 patients with age group of 12–70 years with laboratory confirmed COVID 19 infections using RTPCR having mild to moderate symptoms were selected.

The demographic data of the confirmed RT-PCR positive patients with mild to moderate symptoms (discharged or home quarantined) were collected and enquired for the symptoms of SSNHL using telecommunication and the patients presenting in ENT OPD with similar complaints were also asked for the history of past Covid-19 infection. A detailed history was taken, neurotological examination was documented and Pure Tone audiometry has been performed. Self-assessment questionnaires regarding tinnitus (THI-Tinnitus Handicap Inventory) were administered before and after treatment. The working diagnosis of SSNHL, as well as the evidence around management options including risks and benefits of systemic steroids was explained to the patient. Blood sugar level monitoring in diabetic patients and associated risks with attending hospital was also explained to the patient and then consultation with the ENT team was arranged on same or next day.

If the agreed treatment is systemic steroids, consent was obtained, and the treatment was given to patients which includes Tab Prednisone 30 mg twice daily for 7 days followed by Tab Prednisone 30 mg once daily for 7 days and tapered by Tab Prednisone 10 mg once daily for 3 days. Multivitamin and mineral supplements were also prescribed along with oral steroids. Blood sugar level monitoring were done on every 3rd day in diabetic patients.

The patient was followed up a week later with audiometry. The patients with improvement or without improvement were asked to complete the course and observation done. We used modified Siegel's criteria to assess the grading of recovery after treatment [6].

Results

Out of the total 280 patients, only 09 patients underwent treatment between April 2021 and September 2021 (Tables 1, 2 and 3).

Table 1 Age & sex wise distribution of study participants

Sr.No	Age group (In Years)	Male (%)	Female (%)	Total (%)
1	12–20	4 (1.4)	3 (1.1)	07 (2.5)
2	21–30	15 (5.4)	11 (3.9)	26 (9.3)
3	31–40	20 (7.1)	21 (7.5)	41 (14.6)
4	41–50	28 (10)	35 (12.5)	63 (22.5)
5	51–60	41 (14.6)	37 (13.2)	78 (27.6)
6	61–70	36 (12.8)	29 (10.4)	65 (23.2)
7	Total	144 (51.4)	136 (48.6)	280 (100)

Our study population has male predominance compared to females. Maximum number of males 41 (14.6%) as well as females 37 (13.2%) were in age group of 51-60 years. While minimum number 4 (1.4%) males & 3 (1.1%) females were found in age group of 12–20 years. Mean age was 48 ± 17 years. Male: female ratio was found to be 1.06:1

Discussion

Despite the considerable literature on Covid-19 and also the various symptoms related to the virus, there’s lack of debate on the link between Covid-19 and hearing.

There are not many mechanisms association with SSNHL and viral infections: neuritis caused by viral involvement of cochlear nerves, leads to cochleitis and peri lymphatic tissues, and the stress response resulting from the cross reaction of the inner ear antigens to viral infections(Wilson 1989).Viral infections may involve cranial nerves, leading to SSNHL, peripheral facial paralysis, or smell and taste disorders [7–9].Histopathological investigation of patients with SSNHL have shown, loss of hair cells and supporting cells without inflammatory infiltrate suggests etiology of idiopathic SSNHL is associated to cellular stress pathways [10]. SARS-CoV-2 is found to bind to the ACE-2 receptors on alveolar epithelial cells and endothelial cells and also seen to be expressed in epithelial cells of middle ear, stria vascularis and spiral ganglion of mice [11], SARS CoV-2 causes an inflammatory response and release of cytokines such as interleukin-1,interleukin-6 and Tumor necrosis factor [12] and it can be provoking the cellular stress mechanism which can ultimately results in persistent sensorineural hearing impairment just in case of SARS CoV-2 infection. Among the various possible etiologies and pathogenesis, mainstream pathophysiological mechanisms for SSNHL attribute its occurrence to microvascular disorders. Microvascular damage as well as other microcirculatory disturbances involving sudden increases in blood viscosity, along with embolic and thrombotic episodes [13], such as within the labyrinthine artery, can interrupt the vascular supply to the cochlea, eventually causing cochlea dysfunction and resulting in SSNHL.Diabetes mellitus (DM) contributes the greatest risks to microvascular disorders.Literature shows that, among patients with SSNHL, diabetic patients had a higher

HbA1c level, more severe hearing loss, poorer prognosis than non-diabetic patients [14].

Symptoms including impaired hearing and/or tinnitus seem to be prolonged in many cases and have substantial consequences on the patients subjective quality of life as suggested by J.F. Thrane in their cohort of 225 Covid 19 patients with sudden chemosensory loss [3]. SSNHL could be an occasional symptom of COVID-19, even in mild manifestations of the disease as the data shows by the Filippo Ricciardiello case series on SSNHL in mild covid 19 and providing knowledge to all the healthcare personnel that could be involved in a possible SSNHL assessment,as early recognition is mandatory [4]. Foteini Stefania Koumpa found that, immediate steroids are the best treatment to improve prognosis. Hearing loss can be a significant cause of morbidity and can easily be missed in the intensive care setting. Being aware and screening for SSNHL following COVID-19 enables an early course of steroids, which offers the best chance of recovering hearing [5]. Other most common ENT manifestations of COVID -19 were studied by Mohammad Waheed El-Anwar which includes sore throat (11.3%) and headache (10.7%), were pharyngeal erythema (5.3%), nasal congestion (4.1%), runny nose or rhinorrhea (2.1%), upper respiratory tract infection (URTI) (1.9%), and tonsil enlargement (1.3%) [15] Patients who received the

Table 2 Distribution of SSNHL patients according to different parameters

Sr.No	Parameter	Parameter	Frequency (%)
1	Laterality	Right	02 (22.2)
		Left	03 (33.3)
		Bilateral	04 (44.5)
2	Other audiovestibular symptoms	No	00(0.0)
3	Comorbidities (diabetes mellitus, hematologic disease, cancers etc..)	Yes	02(22.2)
		No	07(77.7)
4	Recovery	Complete	02 (22.2)
		Partial	04 (44.5)
		Slight improvement	01(11.1)
		No recovery	02 (22.2)

Among laterality, bilateral symptoms were maximum found in 4 patients (44.5).We also observed that 7 patients without comorbidities (77.7) and 2 of them with comorbidities developed the disease (22.2)

Table 3 Data showing recovery pattern in individual ears

Sr.No	Recovery	Right recovery	Left recovery	Total (%)
1	Complete	2 (33.3)	2 (28.57)	4 (30.76)
2	Partial	2 (33.3)	3 (42.85)	5 (38.46)
3	Slight	0 (0)	1(14.28)	1(7.69)
4	No recovery	2(33.3)	1 (14.28)	3 (23.07)
5	Total	6 (100)	7 (100)	13 (100)

The recovery pattern for individual ears shows that left ear recovery is 7(53.8) and right ear recovery is 6(46.1)

Table 4 Time from onset of COVID-19 symptom to onset of SSNHL and from onset of SSNHL symptom to first consultation of doctor

No. of patients	1	2	3	4	5	6	7	8	9	Median
Time from onset of COVID-19 symptom to onset of SSNHL [days]	15	20	10	12	8	9	11	14	13	12.4
Time from onset of SSNHL symptom to first consultation of doctor and initiation of treatment [days]	5	6	25	13	15	13	10	14	28	15.1

Shows that out of 9 patients, 4 patients experienced SSNHL during recovery period from SARS CoV-2 and rest 5 experienced symptoms after they became RTPCR negative for SARS Co-V2 (duration of Covid-19 illness differ for individual patients), and it also shows that 2 of them undergone early treatment less than 7 days (22.2), 4 of them received treatment in between 7 days and 15 days (55.5) and rest of the 3 patients got delayed treatment in more than 20 days (22.2)

combined steroid therapy as the initial modality had a better overall hearing improvement rate than did the salvage group in a study of Modified Siegel's criteria for sudden sensorineural hearing loss by Yen-Fu Cheng and they had found that treatment within the first 14 days yielded a better hearing improvement rate than did late treatments of more than 14 days, especially in patients with a pre-treatment hearing grade of 5 [6]. Vural Fidan detected increased incidence of SSNHL during the COVID-19 widespread compared to the same interval of the prior year; 60.3% of subjects confronting with SSNHL had signs that were harmonious with COVID-19 [16]. The sudden SNHL may be the only symptom in COVID-19 patients as observed by Santhosh Kumar Swain in their study of SSNHL in Covid 19 patients at an Indian teaching hospital. This study brings awareness among clinicians and researchers to look for SARS-CoV-2 infections in patients with SSNHL [17].

In our study based on NIH guidelines [18], patients having mild to moderate symptoms of Covid-19 symptoms were included, to make the follow up easier and to avoid the misinterpretation of clinical data that could be due to severity of syndrome. It has been found that SSNHL is observed even in milder presentation of COVID-19 disease and also during recovery stage of the infection.

In our study, out of 9 patients all experienced audio-vestibular symptoms > 7 days of COVID-19 diagnosis (Table 4), Patient no:1, patient no:2, patient no:7 and patient no:9 experienced SSNHL after their recovery from SARS CoV-2 infection and had bilateral SSNHL. patient no:3 and patient no:6 had right SSNHL and symptoms experienced during course of COVID-19 treatment. patient no:4, patient no:5 and patient no:8 had left SSNHL among which only patient no:5 had symptoms during course of COVID 19 treatment and rest two had SSNHL after their recovery from SARS CoV-2 infection.

When the results are observed, it has been found that most of our patients (patient no:5–8) achieved partial recovery of auditory function, patient no:1 and patient no:2 had complete recovery who have received the treatment at the earliest, slight improvement seen in patient no:4, with no recovery in patient no:3 and patient no:9, might be due

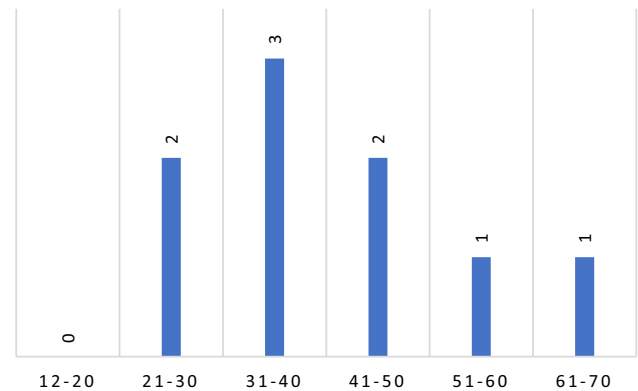
AGE WISE DISTRIBUTION

Fig. 1 In our study the age group of less than 50 years was found to be higher, 7 patients (77.7%) and only 2 patients (22.2) were found above 50 years

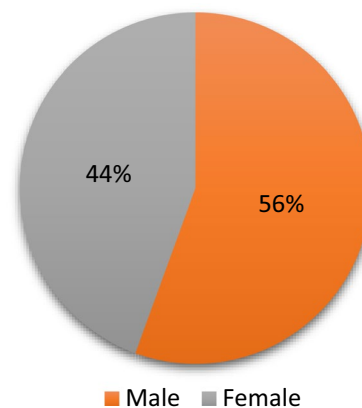
MALE - FEMALE Ratio

Fig. 2 In our study, 5 (56%) patients were males and 4 (44%) patients were females

to their comorbidities and delay in treatment of SSNHL (Figs. 1 and 2, Tables 5 and 6) and a significant reduction in tinnitus is also observed (Figs. 3, 4 and 5).

Table 5 Pattern of recovery with respect to initiation of SSNHL treatment

Recovery Pattern	Onset of treatment (Number of patients)			Total (%)
	< 7 days	7–15 days	> 15 days	
Complete recovery	02(22.2)	00	00	02(22.2)
Partial recovery	00	04(44.4)	00	04(44.4)
Slight improvement	00	01(11.1)	00	01(11.1)
No improvement	00	00	02(22.2)	02(22.2)
Total(%)	02(22.2)	05(55.5)	02(22.2)	09(100)

Shows that the patients who received early treatment in 7 days were fully recovered(22.2), patient received treatment in 7–15 days were partially recovered(44.4) and those who received late treatment in more than 20 days has not improved from the disease(22.2)

Table 6 Correlation of Recovery pattern with other parameters

Patient	Sex	Age	Co Morbidities	Onset of treatment	Pattern of recovery
1	M	29	Nil	< 7 Days	Complete recovery
2	F	28	Nil	< 7 Days	Complete recovery
3	M	56	Diabetes mellitus	7–14 Days	Slight improvement
4	M	48	Nil	7–14 Days	Partial recovery
5	M	39	Nil	7–14 Days	Partial recovery
6	F	36	Nil	7–14 Days	Partial recovery
7	F	38	Nil	7–14 Days	Partial recovery
8	F	48	Nil	> 14 Days	No recovery
9	M	62	Diabetes mellitus, Hypertension	> 14 Days	No recovery

Combined information of patients with their recovery in relation with contributing factors such as age, Comorbidities and onset of treatment

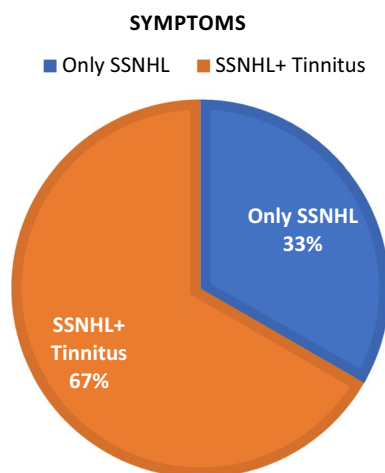


Fig. 3 Out of 9, 6(67%) patients were presented with SSNHL + Tinnitus and 3(33%) patients were having only SSNHL

We also observed that when compared with previous scenarios on SSNHL our study shows SSNHL predominance in younger age group and also in patients with no comorbidities (Table 2).

All our patients undergone medical treatment for SSNHL including oral steroids and neuromodulator drugs. It has been observed that prompt recognition of SSNHL symptoms and early treatment provides good prognosis and vice versa. Patients with no recovery were guided for hearing aids as a part of rehabilitation.

Fig. 4 Pre & post- treatment average hearing levels of right ear. PTA RT-Pure tone audiometry of right ear before treatment (decibel of hearing loss), 7D RT-Right ear recovery on 7th day of treatment, 14D RT-Right ear recover on 14th day of treatment

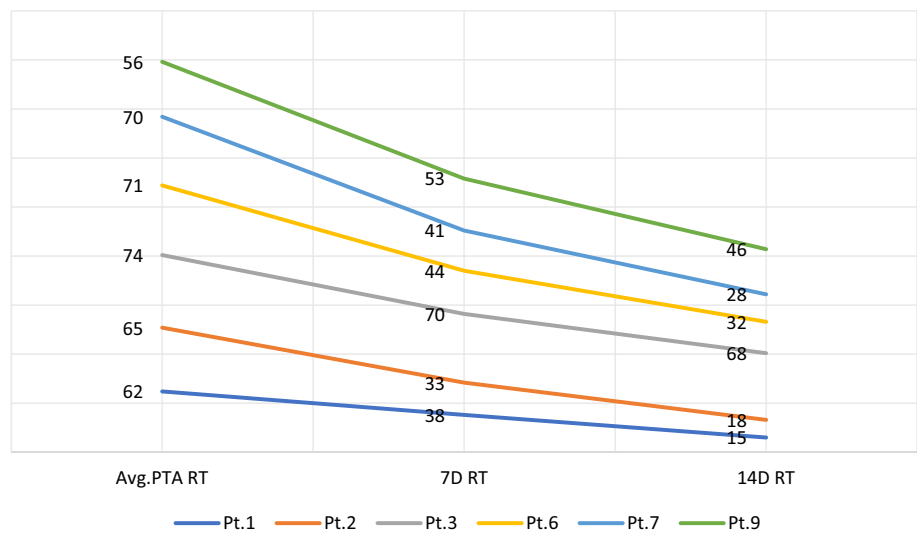
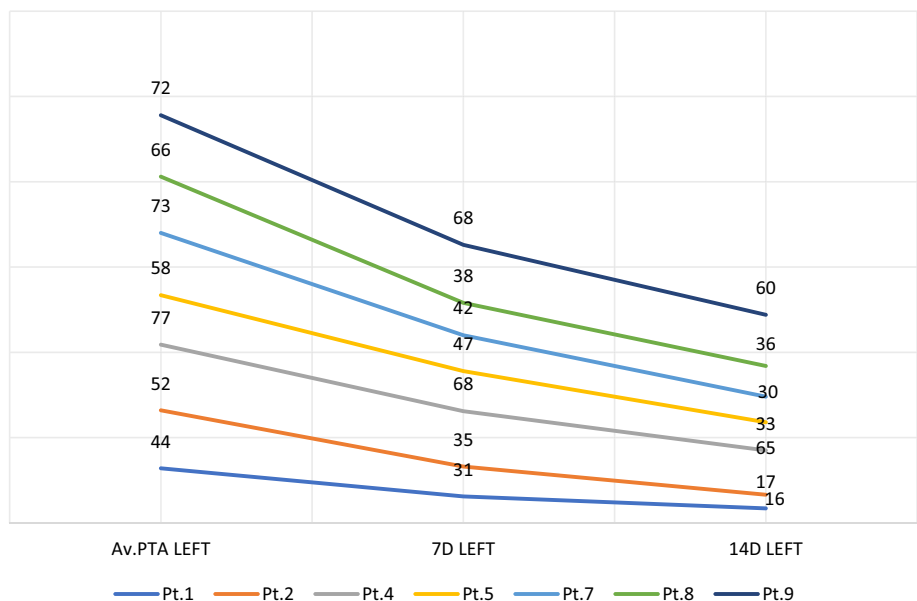


Fig. 5 Pre & post- treatment average hearing levels of left ear. PTA LT-Pure tone audiometry of left ear before treatment (decibel of hearing loss), 7D Left-left ear recovery on 7th day of treatment, 14D Left-Left ear recovery on 14th day of treatment



Conclusion

SSNHL can appear following COVID-19, even in mild manifestations of the disease. The incidence of SSNHL during Covid 19 pandemic appears to be higher than (3.2%) before the pandemic (0.005–0.16%) and also shows SSNHL predominance in younger age group as well as patients with no comorbidities. Our study suggests that prompt recognition of the symptoms and early treatment including oral steroids and neuromodulator drugs plays a major role in the better prognosis of the disease. Increasing age, associated comorbidities and delayed treatment of SSNHL leads to poor outcome. Awareness of such non-specific presentation of Covid 19 patients is crucial and

providing knowledge to healthcare personnel regarding this scenario is vitally important in decreasing the hearing loss associated morbidity.

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Declarations

Conflict of interest None.

Ethical Approval Research proposal was discussed and approved by the Ethics Committee.

Informed Consent A written informed consent were taken from all patients who were part of the study.

Human and Animal Rights All procedures performed in studies involving human participants were in accordance with the institutional ethical standards.

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