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Can Audiometry/Tympanometry Unravel If Our Masks Not Allowing Our Ear Drums To Vibrate Freely?

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Corresponding Author:
Dr. Deepak Gupta,
Anesthesiologist, Wayne State University, 48201 - United States of America

Submitting Author:
Dr. Deepak Gupta,
Anesthesiologist, Wayne State University, 48201 - United States of America

Other Authors:
Dr. Shushovan Chakrabortty,
Clinical Associate Professor, Wayne State University, Anesthesiology - United States of America
Dr. Serafina Romano,
AuD, CCC-A, Private Practice, Audiology - United States of America

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Author(s): Gupta D, Chakrabortty S, Romano S

My Opinion

It happens to be a chance real observation and a chance theoretical interpretation. It is just an amusing tell-tale that what people are saying and what we are hearing is not exactly the same when they or we especially when they and we are wearing masks. So, the question arises how the masks are affecting our hearing [1]. Are the masks interfering in their sound production and transmission under the masks? Or are the masks interfering in our sound reception and perception under the masks? Or both? We cannot check them. Therefore, we have been considering checking our own selves for some time.

The thought to investigate is simple. Are our masks allowing our ear drums to vibrate freely? The underlying theory is that if eustachian tubes get blocked, our hearing changes [2]. The underlying theory is that if air pressures in our aural apparatus change, our hearing changes. Thus, the primary question is whether our masks are blocking our eustachian tubes from freely opening. The primary question is whether our masks are changing the air pressures in our aural apparatus [3-6]. The secondary question is whether our masks induced hot and humid micro-climate is facilitating the opening of eustachian tubes to counter the changed air pressure induced secretions resulting blockade of our eustachian tubes [7].Â Â Â

Herein comes the difficulty to investigate in the times of COVID-19 pandemic even when it seems more likely than ever to share scientific investigations and the results therein with the rapidly adapting biomedical world and eagerly listening general population.

- Is it easy to pursue internal review board review and approval for something as meager as hearing impairment under the masks in the times when COVID-19 pandemic is warranting and mandating all to wear the masks to save lives?
- Is it dangerous to ask ourselves to remove our masks while asking others to investigate our ear drums only for the sake of research investigation into our chance observation?
- Is it medicolegally liable for others to conduct research investigation into our chance observation without ruling out COVID-19 test status of all involved during this research investigation?
- Is it logical to expose oneself to the eventuality of testing, tracing, quarantining and isolating in case things go south during the research investigation for our chance observation in the midst of surging resurging pandemic?
- Can hearing impairment quantification while wearing masks be a temptation for self-experimentation to inspire future and formal research investigation?

Essentially, we have been hearing about hearing impairment caused by masks. Now is the time to investigate how true this is. The option is either to self-experiment or to pursue formal research. As self-experiment may not be publishable and formal research may not be feasible [8], we are just sharing our envisaged protocol which resourceful investigators around the world can consider worth exploring as formal research.

Envisaged Materials and Methods

After institutional review board approval, forty healthcare workers can be consented as human volunteers to participate in this research. Exclusion criteria can be based on intra-aural pathologies discovered at the time of baseline otoscopy, baseline middle ear dysfunction discovered at the time of baseline tympanometry, and baseline hearing loss discovered at the time of baseline pure-tone audiometry. Thereafter, the only observed findings at each time point can be:

- The tympanometry results recorded as bilateral tympanogram types A or B or C [9]
- The pure-tone audiometry results recorded as bilateral hearing thresholds at 250 Hz to 8000 Hz [10]

The time points when these findings can be observed can be as follows:

- Day 1: All forty healthcare workers being observed for immediate changes soon after putting up barrier devices on face as follows:
  - Time 1: Without mask
  - Time 2: With surgical mask

    - Time 3: With N95 mask
    - Time 4: With dual mask (surgical mask over N95 mask)
    - Time 5: With triple barrier (face shield over surgical mask over N95 mask)
- Day 2: Forty healthcare workers randomly divided into four groups being observed for delayed changes due to putting up barrier devices on face as follows:
    - Group 1: Wearing surgical mask for 8hrs
    - Group 2: Wearing N95 mask for 8hrs
    - Group 3: Wearing dual mask (surgical mask over N95 mask) for 8hrs
    - Group 4: Wearing triple barrier (face shield over surgical mask over N95 mask) for 8hrs
        - Hereby in each group, each test finding can be observed at following time:
            - At 0hrs
            - At 4hrs
            - At 8hrs

Expected Line Of Results

We envisage whether the above-mentioned envisaged materials and methods can detect (a) any changes in tympanograms from flattening of peak compliance (static admittance) to Type A potentially converting itself to Type B immediately or after long exposure to barrier devices on face, and/or (b) any changes in audiograms from increasing thresholds at higher frequencies potentially overflowing into increasing thresholds across all frequencies immediately or after long exposure to barrier devices on face, and/or (c) any detectable changes in tympanograms and/or audiograms being related to the types of barrier devices (surgical mask vs N95 mask vs dual mask vs triple barrier) used over the face.

Conclusion

Summarily, we envisage some or many among the readers of our opinion piece getting inspired to investigate hearing impairments in response to barrier devices on face and validate/refute expected line of results as envisaged by us so that we can be sure if hearing impairment is not an idiosyncratic observation by us inciting our idiosyncratic interpretation.

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