ORIGINAL ARTICLE

Oxytocin Effects in Blood Stream of Cardiovascular System-Comprehensive Models of Listening to Relaxing Music for Curing(or Preventing)Covid-19 in Clinic

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ABSTRACT

COVID-19 pandemic has killed more than 6.4 million and infected more than 587 million people in the whole world as of 08/14/2022. How to cure (or prevent) COVID-19 is still an urgent issue in clinics. Applying oxytocin in treatment and prevention of COVID-19 was discussed in a previous review. The application is listening to soothing or relaxing music that can decrease heart rates by increasing oxytocin in blood stream. However, we have not found any publications to describe the mechanism of the relaxing music therapies to cure (or prevent) COVID-19 in comprehensive perspectives of hematology, hemodynamics, biomedical engineering and music. Therefore, in this study, we propose comprehensive models relaxing (soothing) music therapies that could cure (or prevent) covid-19 in clinic. The models respectively describe a correlation between heart rates of normal adult people at rest and tempo rates of the relaxing music, mappings of the human hearing frequencies and relaxing music pitches; and how oxytocin in blood stream of cardiovascular system could clinically cure (or prevent) covid-19 by listening to relaxing music. After analyzing the published information in hematology and (or) clinical studies, we model the mechanism of the relaxing music to cure (or prevent) COVID-19 as the following ordered activities: 1) Relaxing music stimulates aural (audio) neuron sensors of the nervous system. 2) The sensors produce, send and deliver the signals to the hypothalamus. 3) The neurons in the hypothalamus generate oxytocin (hormone). 4) The oxytocin flows to, is stored in and released by the posterior pituitary glands of the endocrine system. 5) The oxytocin is released into the blood stream of the cardiovascular system. 6) The oxytocin reduces cell activities. 7) The reduced activities decrease oxygen consumption. 8) The decreased oxygen consumption decreases the blood flow, heart rate, and the burden of the cardiovascular system. 9) The decreased blood flow deceases the blood pressure. 10) The decreased blood pressure and cardiovascular burden could cure (or) prevent COVID-19 and other respiratory diseases.

Key words: Oxygen (O_2) consumption, oxytocin, heart rate, COVID-19, relaxing music, tempo, pitch.

INTRODUCTION

COVID-19 pandemic has killed more than 6.4 million and infected more than 587 million people in the whole world as of 08/14/2022.[1] How to cure (or prevent) COVID-19 is still an urgent issue in clinics.

Our previous studies elucidate that people can prevent COVID-19 by wearing face mask, washing hands, cleaning upper respiratory tract, drinking adequate boiled water and doing moderate exercise in perspective views of hematology,[2] hemodynamics[3] and public health.[4-6]

Previously, we also investigated automation (ignition and maintain), transportation, propagation and orientation of the cardiac cellular and sub-cellular vibrations (oscillations) and resonances; we modeled auto-rhythmic cells (sinoatrial node cells (SANC), atrioventricular node cells (AVNC), Purkinje

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fibers), non-auto-rhythmic ventricular myocytes and their sarcoplasmic reticulums (SR) as biological liquid plasma resonators that are related to heart rates.[7]

A recent review article summarizes the current understandings of cardiovascular pathogenesis caused by COVID-19, explores the protective potentials of oxytocin against COVID-19 associated cardiovascular diseases, and discusses challenges in applying oxytocin in treatment and prevention of COVID-19.[8] One of the applications is listening to soothing or relaxing music that can decrease heart rates by increasing oxytocin in blood stream.[9-10]

Clinic trials demonstrated experimental groups that received relaxing music showed significantly lower levels of electrodermal response, myocardial oxygen consumption and respiration rate than the control group.[11-12] The experimental group which received relaxing music also showed a significant reduction in state anxiety than the control group.[11]

However, we have not found any publications about the mechanism of the relaxing music therapies to cure (or prevent) COVID-19 in comprehensive perspectives of hematology, hemodynamics, biomedical engineering and music.

Therefore, in this study, we propose the comprehensive models of the relaxing (soothing) music therapies that could cure (or prevent) covid-19 in clinic. The models respectively describe a correlation between heart rates of normal adult people at rest and tempo rates of the relaxing music, mappings of the human hearing frequencies and relaxing music pitches; and how oxytocin in blood stream of cardiovascular system could clinically cure (or prevent) covid-19 by listening to relaxing music.

METHODS

In this study, we use published information of COVID-19,[1] hematology,[13] clinic trials[9-12], cardiology and physiology[14-17], music,[18-19] music therapy,[20-21] biochemistry,[13] statistics[22] and group theory[23]. We apply Microsoft Excel to perform statistic works.

MODELING RESULTS

Music therapists suggest that the relaxing music selections have the tendency to have a tempo of approximately 60,[20] 72 or 76[21] beats per minute (bpm) with pitches (frequencies) centered around C5 (an octave above middle C or C4).[20]

The Relaxing Music Selections of Pitches (Frequencies)

A human cochlea has about 2 and 3 quarter turns, 990o totally.[17] A normal people can hear about 11 octaves totally with a frequency range between 20 Hz and 20,000 Hz[17] or 38,000 Hz.[18] The most sensitive frequencies human perceive are from 1000 to 4000 Hz.[17]

We previously developed a model to map the relationship between a human cochlea spiral angles and the sound frequencies.[19] Based the mapping model, the pitch C5 (see Table 1) is just the 5th pitch C (from the ceiling) of the 11 octaves at an spiral angel of -180o and a frequency of 512 Hz of a human cochlea. See Table 1 and Figure 1, the bold data 64 Hz < frequency < 8192 Hz and -450o < angel < 180o are the mostly musically effective.

Figure 1 illustrates our mathematical model of a logarithmic spiral function with a base 2, in a polar coordinates system, to plot a screw variation of pitches with rotations of a human cochlea.[19] The vibration involves a 3 dimensional motion: a screw radius r, an spiral angle q and a rotational axis z. The rotational axis is perpendicular to the both radius and angle. While the screw rotates about its axis, it translates in z direction too. Therefore, the pitch not only repeats but also lower or higher an octave every ¼ (360o/4) turn. We define a symbol P4O to denote the screw pitch variation. P denotes the screw pitch, subscript 4 denotes a ¼ (360o/4) turn or a 4 fold rotation axis,[23] subscript O denotes a screw octave variation.

From Table 1 and Figure 1, we can see the C5 positions of the octave pitch and spiral angle are approximately at the centers of the human hearing range and cochlea respectively, and the pitches around C5 are a little below the human most sensitive hearing frequencies.

Therefore, we consider human cochlear oscillation frequencies as natural pitches of a cochlea and music frequencies as forced pitches of an environment, resonant (harmonious) pitches occur when the two sets of frequencies are (almost) equal.[19] We hypothesize, at the resonant and sub-sensitive frequencies, the aural system cost the minimum energy to maintain normal and basic hearing functions.

Table 1: Our Model of Spiral Angles, Sound Frequencies, Pitches and Octaves of a Human Cochlea. See Figure 1 and the Text.

Angle (°)	Frequency (Hz)	Pitch (Hz)	Octave (Floor)	Octave (Ceiling)
-∞	0			
-810	1	C-2		
-720	8	C-1		
-630	16	C0	1st	
-540	32	C1	2nd	1st
-450	64	C2	3rd	2nd
-360	128	C3	4th	3rd
-270	256	C4	5th	4th
-180	512	C5	6th	5th
-90	1024	C6	7th	6th
0	2048	C7	8th	7th
90	4096	C8	9th	8th
180	8192	C9	10th	9th
270	16384	C10	11th	10th
360	32768	C11	12th	11th
450	65536	C12	13th	12th
∞	∞			

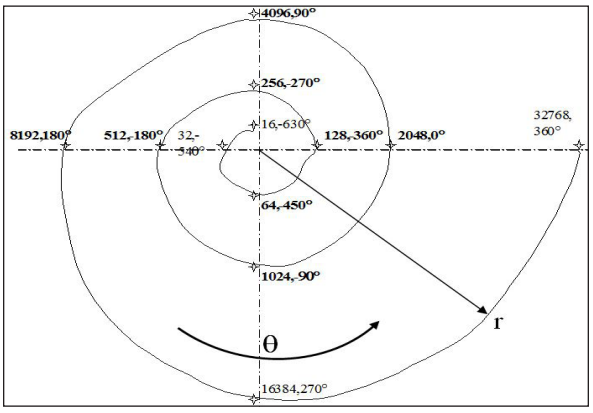

Figure 1. Our model of octave pitches (frequencies) within the hearing range of a human cochlea: screw radius r and spiral angle q. The screw axis z is perpendicular to the both radius and angle.[19] The draw is not to the scale. See Table 1 and the text.

The Relaxing Music Selections of Tempo Rates

When resting, the adult human heart rates are on average about 65,[14] 70[15] or 73[16] beats per minute (bpm). Table 2 and Figure 2 show comparisons between averaged heart rates of normal people at rest and tempo rates of the relaxing music. The comparing number denotes an order of the comparison with each couple of data in the two sets of rates. The Pearson Product Moment correlation coefficient is 95.5% that can be considered very highly correlated between the two sets of rates.[22]

Therefore, we consider a human heart rate as a natural tempo rate and a music tempo rate as a forced tempo rate of an environment, a resonant (harmonious) tempo occurs when the natural and forced tempo rates are (almost) equal. The cardiovascular system can cost the minimum energy, i.e., can use the lowest oxygen consumption, to maintain a normal and basic function of the system.[7]

Just like dancing, we feel it's easy to dance well if we follow the music tempo rates; otherwise, we feel it's hard to dance well.

Table 2: Comparing Heart Rates of Normal Human People at Rest and Tempo Rates of the Relaxing Music. bpm: Beats Per Minute. See Figure 2 and the Text.

Comparing Number	Heart Rate (bpm)	Music Tempo Rate (bpm)
1	65	60
2	70	70
3	75	73

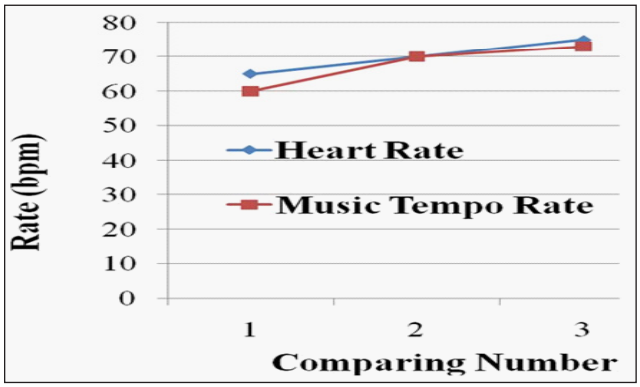

Figure 2. Comparison between heart rates of normal people and tempo rates of the relaxing music. bpm: beats per minute. See table 2 and the text.

The Relaxing Music Could Cure COVID-19 by Producing and Releasing Oxytocin into Blood Stream

After analyzing the published information in hematology and (or) clinical studies[9-21], we model the mechanism of the relaxing music to cure (or prevent) COVID-19 as the following ordered activities:

Relaxing music stimulates aural (audio) neuron sensors of the nervous system

The sensors produce, send and deliver the signals to the hypothalamus

The neurons in the hypothalamus generate oxytocin (hormone)

The oxytocin flows to, is stored in and released by the posterior pituitary glands of the endocrine system

The oxytocin is released into the blood stream of the cardiovascular system

The oxytocin reduces cell activities

The reduced activities decrease oxygen consumption

oxygen consumption = oxygen delivered by blood flow[17]

the blood flow is proportional to heart rate[17]

The decreased oxygen consumption decreases the blood flow, heart rate, and the burden of the cardiovascular system.

The decreased blood flow deceases the blood pressure, since

The blood pressure (difference) = product of the blood flow and flow resistance[17]

We assume the resistance is approximately a constant here.

The decreased blood pressure and cardiovascular burden could cure (or) prevent COVID-19 and respiratory diseases

Our previous models[4-6] have explained why some people, who are difficult to breath with or without mask-wearing, do not like to wear a face mask during the pandemic of COVID-19, because of hard oxygen diffusion or transportation. Listening to the relaxing music could help these people to cure (or prevent) the disease because of decreased oxygen consumption.

DISCUSSION

We think the tempo rates and frequencies of relaxing music are most familiar to people, they are the results of millions of years of human evolution through interactions between the people and environments.

We also believe music therapy via telehealth is helpful to cure or prevent other diseases clinically during the COVID-19 pandemic.[24-26]

CONCLUSION

Relaxing music enhances oxytocin (hormone) in the blood stream of the cardiovascular system, the oxytocin reduces decrease cellular oxygen consumption, and the decreased oxygen consumption decreases the blood flow and heart rate of the cardiovascular system. Therefore, the decreased flow and (or) rate could cure (or) prevent COVID-19 and other respiratory diseases by decreasing the blood pressure and cardiovascular burden.

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