The Journal of the

IYNA

*International Youth Neuroscience Association*

The Auditory and Vestibular Systems

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FEATURED ARTICLES

‘Tottering and Technology: An Overview of Vestibular Prosthetics’ by Dhanya Mahesh

‘Hearing Loss and Deafness: An Overview’ — by Lorryane Isidoiro Gonçalves

‘Basics of Neuroscience VI: An Introduction to Neuroanatomy’ — by Alexander Skvortsov

‘Research Methods: Human Experimentation’ — by Jacob Umans
## Contents

### INTRODUCTION

<table>
<thead>
<tr>
<th>Article</th>
<th>Author</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>A Message from Dr. Norbert Myslinski</td>
<td>Norbert Myslinski</td>
<td>2</td>
</tr>
<tr>
<td>Letter from the Editor</td>
<td>William Ellsworth</td>
<td>3-4</td>
</tr>
<tr>
<td>Update from the Chairmen</td>
<td>IYNA Board of Directors</td>
<td>5-6</td>
</tr>
</tbody>
</table>

### GENERAL NEUROSCIENCE

<table>
<thead>
<tr>
<th>Article</th>
<th>Author</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basics of Neuroscience VI: An Introduction to Neuroanatomy</td>
<td>Alexander Skvortsov</td>
<td>7-15</td>
</tr>
</tbody>
</table>

### NEW TECHNOLOGY

<table>
<thead>
<tr>
<th>Article</th>
<th>Author</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tottering and Technology: An Overview of Vestibular Prosthetics</td>
<td>Dhanya Mahesh</td>
<td>16-18</td>
</tr>
</tbody>
</table>

### DISEASE

<table>
<thead>
<tr>
<th>Article</th>
<th>Author</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bilateral Vestibular Hypofunction</td>
<td>Priya Vijaykumar</td>
<td>19-21</td>
</tr>
<tr>
<td>Hearing Loss and Deafness: An Overview</td>
<td>Lorryane Isidoro Gonçalves</td>
<td>22-25</td>
</tr>
<tr>
<td>Meniere’s Disease: A Summary</td>
<td>Christian Gonzalez</td>
<td>26-29</td>
</tr>
</tbody>
</table>

### RESEARCH

<table>
<thead>
<tr>
<th>Article</th>
<th>Author</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research Methods: Human Experimentation</td>
<td>Jacob Umans</td>
<td>30-32</td>
</tr>
<tr>
<td>Research Summary: The Effects of Music Listening on Pain and Stress in the Daily Life of Patients with Fibromyalgia Syndrome</td>
<td>Meenu Johnkutty and Shreyas Parab</td>
<td>33-36</td>
</tr>
</tbody>
</table>

### NEUROETHICS

<table>
<thead>
<tr>
<th>Article</th>
<th>Author</th>
<th>Page</th>
</tr>
</thead>
</table>

### SATIRE

<table>
<thead>
<tr>
<th>Article</th>
<th>Author</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>40-41</td>
</tr>
</tbody>
</table>

### CONTRIBUTORS PAGE

<table>
<thead>
<tr>
<th>Article</th>
<th>Author</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>42</td>
</tr>
</tbody>
</table>
A Message from Dr. Norbert Myslinski

Norbert Myslinski

We are on the threshold of a great educational movement, a movement to create a place for neuroscience in high schools across the world. The International Youth Neuroscience Association is in the forefront, spearheading this movement. We are revolutionaries. We can be proud of our accomplishments, but this is just the beginning. We will be instrumental in growing neuroscience clubs and courses in schools across the world; in inspiring young men and women to enter the neuroscience professions to help treat and find cures for brain disorders; in promoting neuroscience concepts to impact our education, health and happiness; and in providing information about the brain that will improve the daily lives of all of us.

Congratulations to our colleagues who will be representing the IYNA at the neuroscience convention in San Diego this month, and to all of our leadership. And I would like to offer a challenge to the IYNA. The official birthday of the IYNA is March 20, 2016. My challenge is to create 2000 neuroscience clubs by March 20, 2020.

Dr. Norbert Myslinski
Founder of the IYNA
Letter From the Editor

William Ellsworth

Readers,

I hope you enjoy the sixth issue of the IYNA Journal! We greatly appreciate your continued (or new) readership.

One of the brain’s most fundamental roles is the sensing of its surroundings. It goes without saying that effective ways of perceiving the environment provide a large selective advantage to any species.

So how, exactly, do we perceive our environment? From a young age, we are taught about our 5 senses: hearing, vision, taste, smell, and touch. But few children learn about the other systems that have evolved to acquire information from our environment—notable examples include our vestibular system, our proprioceptive system, and our nociceptive system.

In this edition of the IYNA Journal, we turn our attention (no pun intended!) to audition and the vestibular system. These two senses are often grouped together, as the sensory organs for both are found in the ears.

Although our senses may seem some of the more simplistic and elementary aspects of neuroscience, there is still a great deal of active research being conducted on hearing and the vestibular system. In the research section, Shreyas Parab and Meenu Johnkuty explain recent research defining the relationship between music listening and pain and stress levels. Jacob Umans discusses human experimentation, particularly in the context of the auditory system.

As with other senses, plenty can go wrong with hearing and the vestibular system. In the disease section, Lorrayne Isidoro Gonçalves provides a primer on hearing loss and deafness; Christian Gonzalez describes Meniere’s Disease.

Of course, we would be remiss not to explore ear-related therapies for disease. In new technology, Dhanya Mahesh reports on vestibular prosthetics as a treatment for vestibular damage. In neuroethics, Mallika Pajjuri outlines the ethical debates surrounding vestibular stimulation as a therapy for anosognosia.
As always, it is critical that we recognize all of our dedicated writers for helping us make this issue the success that it is. You can find all of their names and positions on our Contributors page.

If you have any questions, comments, or suggestions for us, please feel free to contact us at info@youthneuro.org. We hope you enjoy our sixth issue as much as we enjoyed writing it!

Best Regards,

William Ellsworth
Editor-in-Chief, IYNA Journal
Update from the Directors

IYNA Board of Directors

Readers,

We all hope you enjoy the sixth issue of the IYNA Journal! We greatly appreciate your continued (or new) readership. While our journal has the most visibility at this point, it is important to highlight several of our other main projects and developments. These include:

New Board of Directors Member:
The IYNA Board of Directors is pleased to welcome Megumi Sano, head of the England Chapter of the IYNA, to the International Board of Directors. She brings with her considerable experience as director of the Synapse Project that will be invaluable in our future development as an organization!

Neuroscience 2016:
With the help of the director of our Founder and Chairman of the Advisory Board, Dr. Norbert Myslinski, the IYNA has been fortunate enough to gain the opportunity to present at Neuroscience 2016, a Society for Neuroscience conference in San Diego. The organization will be represented by Jacob Umans, one of the presidents of the IYNA, and Karina Bao, the 2016 USA Brain Bee Champion. At the conference, the pair will raise awareness of the IYNA among neuroscientists who may be willing to support the organization’s cause.

MYELIN Initiative Update:
The MYELIN Initiative is a program facilitated by the IYNA that seeks to provide students worldwide with comprehensive, understandable, and accessible neuroscience education. If you are interested in assisting with the MYELIN initiative, please contact us at info@youthneuro.org, or send us an inquiry on our website: youthneuro.org
Best Regards,

Jacob Umans and Nicholas Chrapliwy
Presidents

Alexander Skvortsov and Janvie Naik
Executive Vice Presidents

Kyle Ryan
Outreach Director

Shreyas Parab
IYNA Treasurer

Megumi Sano
IYNA Board Member

William Ellsworth
Editor-in-Chief
Basics of Neuroscience VI: An Introduction to Neuroanatomy

Alexander Skvortsov

Introduction

Like most complex organ systems, the nervous system is composed of many parts. One can consider the brain on the scale of hemispheres, regions, neural circuits, individual neurons, or even on molecules. In previous editions of Basics of Neuroscience, we have considered the cellular composition of the brain, neural communication (both intracellular and extracellular), processes of strengthening of neural connections, and the process of addiction. As you might noticed, these topics mainly concern the brain on a cellular scale. To better understand the processes of the human nervous system, one must be able to connect cellular processes to a larger picture of neuroanatomy. This month’s article shall discuss the anatomy of the central nervous system.

Directional Terminology

Before discussing the anatomical structure of the brain, it is important to first understand formal directional terminology used by scientific professionals in various medical, research, and clinical fields. These terms are used to describe relative location of a point.

Anterior (rostral)
A directional term used to indicate location towards the front of the brain

Posterior (caudal)
A directional term used to indicate location towards the back of the brain

Lateral
A directional term used to indicate location towards a side of the brain

Dorsal
A directional term used to indicate location towards the top of the brain

Ventral
A directional term used to indicate location towards the back of the brain
Superior
A directional term used to indicate location above that of a reference point

Inferior
A directional term used to indicate location below that of a reference point

Medial
A directional term used to indicate location at the midpoint of the brain

Observation of the Central Nervous System

In order to label, divide, and categorize the brain, we must first understand how to properly observe it. The central nervous system, henceforth referred to as the CNS, is composed of the brain and the spinal cord, and is contained within the cranial cavity and the spinal canal, respectively. Upon death of an individual, blood flow to the brain ceases, triggering a breakdown of neurons. To counter this deterioration, scientists perform a process known as fixation, which essentially stabilizes the structure of the brain, generally either by freezing or through the use of a formalin solution.

After the brain has been successfully fixated, researchers proceed to separate it in order to observe internal regions. In a standard separation, the cerebellum is separated from the cerebrum and spinal cord. The cerebrum and cerebellum are then dissected separately. Three main types of cuts are used to accomplish this dissection. Horizontal cuts section the brain into horizontal slices from top to bottom. Coronal cuts divide the brain into vertical slices done perpendicularly to the longitudinal cerebral fissure (the primary division between the two cerebral hemispheres). Sagittal cuts are vertical slices done parallel to the longitudinal cerebral fissure. The Mid-Sagittal cut, which is also known as the medial cut, is a special plane of view which separates the cerebral hemispheres along the longitudinal cerebral fissure.

Upon cutting the brain, one can notice its relatively bland coloration. Unlike one could assume from the many colorfully labeled diagrams so often found in textbooks, the brain can be described as a mixture of white and gray. Gray regions of the brain, primarily known as gray matter, such as the outer cerebral cortex and the many internal nuclei, are mainly composed of dendrites and somas and handle most of the computational processes described in Basics of...
Neuroscience III, while white regions, conventionally referred to as white matter, consist mostly of axons.

**Anatomical Division**

We can visualize the division of the central nervous system—the brain and spinal cord—in several different ways. An informal approach simply separates the brain into the brainstem, cerebrum, spinal cord, and cerebellum. The cerebrum can then be divided into 2 hemispheres.

A more formal approach to anatomical division, however, takes use of Latin terminology. The brain as a whole, is referred to as the Encephalon. The Encephalon is then divided into two major regions known as the Prosencephalon, or forebrain, and Rhombencephalon, or hindbrain.

The Prosencephalon can be further divided into the Telencephalon, which contains the cerebral cortex, and basal ganglia, and the Diencephalon, which contains the Thalamus and Hypothalamus, as well as the third ventricle. The Rhombencephalon is divided into the Mesencephalon, which contains the midbrain, Metencephalon, which consists of the pons and cerebellum, and Myencephalon, which consists of the medulla oblongata.

While the Latin approach is considered more formal, convenience often brings neuroscientists to use the more casual classification of basic neural regions.

In addition to the inner composition, the brain is covered throughout by three levels of meninges called the Dura Mater, Arachnoid Mater, and Pia Mater. The Dura Mater is very tough, thick, and mostly opaque. The Arachnoid mater is a thinner, inner layer which can be compared to a spidersilk-resembling material. Finally, the Pia mater is the most delicate covering and directly adheres to the brain. The Pia Mater contains many of the blood vessels on the surface of the brain.

**Cerebral Hemispheres**

The Prosencephalon, conventionally known as the forebrain, is the region generally associated with the cerebrum. The forebrain encompasses most of the brain, with the exception of the midbrain, brainstem, and cerebellum. For the most part, the forebrain can be divided into two cerebral hemispheres with relative ease by cutting along the longitudinal cerebral fissure: the major division between the two hemispheres. However, this is not to say that the two hemispheres are symmetrical, either structurally or functionally.
The adult human brain is generally lopsided, with the left hemisphere slightly larger than the right. In terms of function, the left brain is traditionally associated with logical, computational, factual, and language-based thinking. The right brain, on the other hand, is associated with creative processes such as art, music, holistic thinking, and imagination. Keep in mind, however, that this association is one of dominance, not one of monopoly. Although one lobe of the brain may be more involved in a given process than another, it is important to remember that, for the most part, both lobes are involved in a given process. A mistaken belief in hemisphere-process monopolization has led to the common perpetuated myth of hemispherical dominance, or that some people have a stronger/larger/etc hemisphere, resulting in increased talent regarding a certain process. This is simply not true, as most processes the hemispheres work in tandem, with some slight unbalance. Cerebral hemispheres are closely linked by a bundle of white matter known as the corpus callosum.

Throughout the brain, an observer can find cavities known as ventricles. In a functioning environment, these ventricles are generally filled with a transparent, colorless fluid called Cerebrospinal fluid, or CSF for short. CSF can be found inside ventricles, as well as surrounding the brain and spinal cord. CSF constantly re-circulates through the brain, and is produced by ependymal cells on a structure called the choroid plexus, which can generally be found inside ventricles. Functions of the CSF include protection and suspension of the brain inside the cranium, chemical stability, and glymphatic cleaning (see Vol 1 Issue 3, The Necessity of Sleep).

The ventricular system contains 4 primary ventricles, each lined with choroid plexus, the subarachnoid space, various cisterns and sulci on the brain, and the central canal of the spinal cord. Two of the ventricles compose a system called the lateral ventricular system- they form an arc shaped area located directly inferior to the corpus callosum, and are divided by a thin membrane known as the septum pellucidum. Below the lateral ventricular system is the third ventricle and extending through the brainstem is the fourth ventricle. The ventricles are connected to each other by a system of passages called the foramina.

Cerebral Lobes
The dorsal surface of the prosencephalon is covered entirely by the 4 cerebral lobes: the Parietal, Temporal, Occipital, and Frontal lobes. The external cerebral lobes consists of 2 main regions: a 6-layered sheet of gray matter known as the cortex, and a thicker layer of white matter. In addition to these 4 external lobes, there also exists an insular cortex which is located below temporal lobe external lobes.

The Temporal lobes are located on the lateral sides of the brain, are divided from the main corpus of the cerebrum by the Sylvian fissures, and are primarily a center for processing of auditory information. The temporal lobe also contains structures important for memory, such as the hippocampus and amygdala. For more information on how the hippocampus and amygdala are involved in memory, see Basics of Neuroscience IV. A very important part of the Temporal lobe is Wernicke’s area, which plays a key role in speech interpretation.

The Occipital Lobe is located at the posterior of the brain and is the primary processing center for visual input to the brain. It includes different visual areas, including V1 (which responds to lines of different orientations) and increasingly complex visual processing areas. This region is connected with several higher brain regions, including V4 (which is linked to color perception) and V5 (which is linked to visual motion).

The Parietal lobe is located at the superior-medial surface of the brain, posterior to the frontal lobe, and is very important for somatosensory functions, such as the integration of pain, temperature, and mechanoreception. It is also involved in spatial coordination and language interpretation. A very important area of the parietal lobe is the somatosensory cortex located at the anterior of the parietal lobe, which serves as a central integration center for somatosensory information.

The frontal lobe is a cortical area located at the anterior part of the brain that is responsible for an extremely diverse set of functions. In short, the frontal lobe is responsible for the integration and analysis of sensory information and the subsequent executive decisions. These include a multitude of decisions ranging from choices and suppression of socially unacceptable behaviors to voluntary movement; the motor cortex located towards the posterior of the frontal lobe also makes the frontal lobe responsible for initiation of movements.

The Insular Cortex is a relatively small, hidden cortical area contained within the Sylvian fissure. While the exact functions of the insular cortex are largely unknown due to lack of comprehensive research, it has been linked to pain, basic emotions, desires, and various social emotions.

**Deep Brain Nuclei**

There exist 2 primary systems of deep brain nuclei located beneath the cortex: the basal ganglia and the limbic system.
The basal ganglia is a complex system of interconnected deep-brain nuclei located inferior to the cerebral cortex. The system is involved in various functions primarily concerning motor planning and coordination, but also including emotion, motor learning (also known as procedural memory), and behaviors. The Basal Ganglia receives direct input from the cortex, and communicates back through the thalamus.

The largest component of the basal ganglia system is the striatum, a compound nucleus composed of the dorsal and ventral striatum, which can further be divided into the putamen and caudate, and the nucleus accumbens and olfactory tubercle, respectively. The striatum is the primary recipient of input signals from the cortex. Other components of the basal ganglia include the globus pallidus, which is primarily composed of inhibitory GABA-ergic neurons and the ventral striatum, which is a key center of pleasure processing and consists of the nucleus accumbens and olfactory tubercle.

The limbic system, although often confused with the basal ganglia, performs a critically different set of tasks, mainly pertaining to emotion, endocrine function, and self-preservation. The limbic system has been conventionally referred to as the “feeling and reacting brain,” in contrast to the cortex being the “thinking brain,” as the limbic system is a more reflexive, primitive part of the brain. The largest and most significant parts of the limbic system are the amygdala, hippocampus, hypothalamus, and limbic cortex.

The hippocampus, as mentioned in Basics of Neuroscience V, is highly linked with memory creation and consolidation, especially concerning declarative (explicit) memory. Some
areas of the hippocampus are partially responsible for other types of memory, such as short-term memory. The hippocampus is responsible for the encoding and retrieval of memories, but not in the storage -- lesions in the hippocampus affect the formation of new memories rather than existing ones, as seen in the revolutionary case of HM, a patient who had his medial temporal lobe (which contains the hippocampus) removed, resulting in extreme anterograde amnesia (See anterograde amnesia, Vol 1 Issue 4). The hippocampus can be divided into the three-layered dentate gyrus, the spiral hippocampal body, which is conventionally divided into four areas, referred to as C1-4, and an area called the subiculum.

The amygdala is also highly involved with memory, primarily linking memory to strong, mostly negative, emotions. As a matter of fact, the amygdala is considered to be the primary region associated with primal, self-preservation emotions, such as fear. This makes sense from an evolutionary perspective, as it allows the brain to link various past negative experiences to unpleasant emotions, thus leading the organism to avoid these experiences. For this reason, the amygdala has reciprocal connections to most other brain regions. The amygdala is a very diverse complex that can be further divided into 13 sub-nuclei.

The hypothalamus is an area that functions primarily as a liaison between the brain and the endocrine hormonal system, as well as to regulate some major areas of human behavior such as sleep. The hypothalamus contains several nuclei that regulate sleep including the suprachiasmatic nucleus- the main driving force of circadian rhythms (for more information see our article on how sleep works (Vol 1 issue 3)). In addition, the hypothalamus is the most sexually dimorphic areas in the brain. The hypothalamus processes its primary task, regulation of the endocrine system, through communication with the pituitary gland; either directly with the posterior pituitary or indirectly with the anterior pituitary. Additionally, the hypothalamus contributes to regulation of autonomic systems (various unconscious processes) using pathways through the brainstem and spinal cord. The hypothalamus almost exclusively regulates temperature, osmosity, hunger, and the aforementioned sleep cycles and processes.

A final major area of the limbic system is the limbic lobe, an arc shaped region of the brain that spans both hemispheres and is located dorsal to the corpus callosum. Two major areas of the limbic lobe are the cingulate gyrus and the parahippocampal gyrus. The cingulate gyrus is strongly linked with many human functions such as emotion, judgement, motivation, reasoning, and pain.

**Brainstem and Cerebellum**

Extending below the cerebrum is a group of structures known as the brainstem, which join the cerebrum and the spinal cord. Considered to be some of the first neural areas to have evolved, the parts of the brainstem primarily regulate various autonomic functions such as breathing, blood pressure, heartbeat, and sleep. For purposes of brevity, this section will focus
exclusively on the following structures of the brainstem: the thalamus, pons, and medulla oblongata.

Located on the extreme superior region of the brainstem is a double-lobed structure known as the Dorsal thalamus, or more conventionally as the thalamus. The executive function of the thalamus is sensory relay; all sensory signals pass, either directly or indirectly, through the thalamus. The thalamus consists of a variety of nuclei which send afferent signals primarily to cortical areas of the brain, in which sensory information is processed, analyzed, and compounded.

Connected superior to the spinal cord is a structure resembling an inverted frustrum called the medulla oblongata. The medulla oblongata serves as a connection between the spinal cord and the cerebrum, and thus serves as a primary relay center for somatosensory information, as well as for the mass of motor signals descending into the somatic nervous system. In addition to this, the medulla oblongata serves as a base for 5 of the 12 cranial nerves which innervate the head and neck. The most important function of the medulla is controlling autonomic functions of the body (basic unconscious processes), such as breathing, heart rate, etcetera. These functions are fulfilled by a neural area called the reticular formation, which is mostly contained within the posterior medulla, although there is some overflow to the Pons.

The Pons is a structure directly superior to the medulla that bulges out from the brainstem, structurally resembling an “adam’s apple”. The pons is quite similar to the medulla as it serves as a relay between the spinal cord and brain, performs as a base for several cranial nerves, and contains the superior region of the reticular formation, thus aiding in various autonomic processes. In addition, the pons plays an important part in the functions of sleep and arousal.

Another extremely important part of the brain is the cerebellum: a bi-lobed structure, of which the outside surface slightly resembles a cauliflower and can be found at the anterior of the brain inferior to the occipital lobe. The cerebellum functions primarily in terms of movement coordination and optimization. An important part of this function is that movement does not originate in the cerebellum, but rather is coordinated and optimized there - instructions for movement originate in the motor cortex of the frontal lobe. The cerebellum is directly responsible for coordination of movements and motor learning, and works with the vestibular system in order to preserve balance. The cerebellum can be divided into several distinct structural areas, namely the cerebellar cortex and the cerebellar deep nuclei. The cerebellar cortex is mainly responsible for processing and integrating data from the various somatosensory systems including the cerebral cortex and the thalamus. An especially interesting aspect of the cerebellum is its histology: The cerebellum is home to one of the most beautiful neurons in the brain- the Purkinje cell. The Purkinje cell is a neuron with extensively branching dendrites; in fact, there can be over 100,000 connections to a single Purkinje cell. Purkinje cells receive an immense volume of input from thousands of small granule cells also located in the cerebellar cortex, and after comprehensive calculation and analysis, relay the resulting information to cerebellar deep-brain nuclei, where it is then processed. These deep-brain nuclei then perform final coordinations and communicate through the spinal cord and the somatic nervous system the
branch of the PNS that organizes voluntary movements) the movement command to muscle fibers throughout the body.

References


Tottering and Technology: An Overview of Vestibular Prosthetics

Dhanya Mahesh

Introduction
Rather than extrasensory perception, maintaining posture and balance is what scientists at Johns Hopkins University call the “sixth sense.” Not unlike the famous five senses, the absence of this sixth sense can have drastic effects on one’s daily life, as shown by those with impaired vestibular systems. With the most common symptoms of vestibular damage being “vertigo, dizziness, nystagmus, and postural imbalance,” treatment or replacement of vestibular function is in high demand. In this age of technology, it is unsurprising that an electronic device acting as a vestibular prosthetic is quickly being developed. Researchers at the University Hospitals in Switzerland and at the University of Washington in Seattle have conducted clinical trials wherein such prosthetics have been placed in human patients and subsequent changes in vestibular functions have been recorded.

Mechanisms of Current Vestibular Prosthetics

Most vestibular prosthetics currently produced work to improve semicircular canal function rather than otolithic function. Large vestibular research centers such as the Johns Hopkins Vestibular NeuroEngineering Laboratory and the University of California at Irvine Microsystems Laboratory have been working to develop implants that conduct electrical signals in the semicircular canals in response to rotational movement rather than in the otolithic organs responsible for linear acceleration.

Current vestibular implants, such as those used at the University of Washington and by researchers in Switzerland, artificially recreate the “push-pull” system of the semicircular canals. This “push-pull” system is demonstrated through the rotation of one’s head and the resulting change in neuron firing rate in the semicircular canals. For example, when one rotates the head towards the right, the nerves in the semicircular canal in the right ear will fire rapidly, allowing the eyes to move in the opposite direction. Similarly, when one rotates the head towards the left, the nerves in the semicircular canal in the left ear will fire rapidly. But for the ear opposite to the direction of head movement, the rate of firing of the neurons in the ear’s semicircular canals decreases. For the rate of firing to increase or decrease depending on head movement, there must be a “spontaneous or baseline firing rate.” Current vestibular implants are developed to contain this baseline firing rate and increase or decrease the rate following a specific head rotational movement. Baseline firing rates are often found using model organisms.

In order to accomplish this, the implant is made with microprocessors connected to electrodes and is placed near different sets of nerves in different sets of patients. Researchers in
Switzerland placed electrodes near the vestibular, posterior ampullary, and lateral ampullary nerves [3]. Likewise, in studies conducted by researchers at the University of Washington, electrodes were placed similarly in a human patient with advanced Ménière’s disease [9].

After placing the electrodes, patients are tested for their ability to conduct rotational movement and appropriate subsequent eye movement accurately. After examining the results, researchers determine if certain placements of electrodes are more effective than others [3].

**Successes and Limitations**

While such vestibular implants are fairly successful in producing appropriate eye movements during rotational head movement, there are large risks and limitations that must be considered [10].

For example, in the study conducted at the University Hospitals in Geneva, Switzerland, “24 out of 27 implanted electrodes in [all] 12 patients” resulted in appropriate eye movement responses. These responses were able to “restore a...reflex with a gain close to normal [3].” Studies conducted at the University of Washington concluded that the “implantation of all semicircular canals was technically feasible [9].” Both of the implants developed in these studies managed to allow some vestibular functionality but the risks of such applications remain high.

The main risk of such implants is the loss of auditory function that may accompany them. At the University of Washington, after examining the effects of a vestibular prosthetic implanted in a Ménière’s disease patient, researchers concluded that auditory function was “largely, but not totally, lost [9]” and researchers at Switzerland estimate that some hearing loss will accompany the implantation of their device [10].

**Future Directions**

Currently, many researchers are working to increase the quality of vestibular prosthetics and lessen the impact of potential side effects. For example, in order to increase the quality of such prosthetics, researchers at Georgia Institute of Technology have developed a “low power ASIC signal processor” to encode head movements [11]. This type of processor will increase the accuracy of vestibular prosthetics by capturing the slightest head movements and sending electrical signals to vestibular nerves [11].

Richard Lewis at Harvard Medical School explains in his article that vestibular prosthetics can be further improved by specifying neuronal firing rates in the vestibular system and also by developing otolith prosthetics to work alongside semicircular canal prosthesis [10]. Swiss researchers are also working to “minimize adaptation time and error” by developing models of “vestibular prosthetic function” using model organisms or software programs [12].

Overall, vestibular prosthetics are a potential way to alleviate the symptoms of those who suffer from vestibular damage. Inability to maintain balance and posture, vertigo, and other common symptoms can be minimized with artificial implants. As of today, vestibular prosthetics
improve vestibular system function only at a great cost, but in an era of rapid technological
development, a fully functional vestibular prosthetic system specifically made for each patient’s
symptoms is on the horizon.

References


Bilateral Vestibular Hypofunction

Priya Vijayakumar

Introduction

Bilateral vestibular hypofunction (BVH) is broadly characterized by the inability to maintain posture and balance, walk in environments with low visibility, and see clearly during head movements [1]. The effects of the disorder are due to decreased vestibular function in the inner ear [2]. BVH was first described by neurosurgeon Dr. Walter Dandy in 1941 [3]. After performing a series of bilateral vestibular neurectomies on patients with Meniere’s Disease, Dandy observed symptoms of oscillopsia and imbalance in the absence of light [4]. The next seventy-five years were significant in demystifying the varying causes for BVH and developing innovative therapies to treat the disorder.

Symptoms

Although symptoms vary among patients, a few are clinically recognized as hallmark indications of BVH. Oscillopsia is the result of reductions in the vestibulo-ocular reflex; eye-movements cohere to head movements rather than stabilizing in opposition to head movements. Due to oscillopsia, blurring of vision produces visual vertigo and causes imbalance which can lead to excessive falling. In the elderly population, falling can be especially dangerous as it is the leading cause of accidental death for people aged 65 and older [1]. On top of these keystone symptoms of BVH, patients may also exhibit cognitive deficits such as difficulties concentrating due to dizziness and disorienting visual environments [3].

Etiology

The majority of BVH cases are idiopathic with heterogeneous origins. Ototoxicity accounts for nearly 50% of BVH cases [5]. Also, the consumption of Gentamicin, a common antibiotic, is widely linked to inducing BVH. Recent research suggests a possible correlation between free radical generation and the development in the BVH as well [6]. The onset of BVH is often triggered by primary infections, disorders, or diseases such as Meniere’s Disease, meningitis, autoimmune disorders, chronic inflammatory peripheral neuropathy, and deafness. Furthermore, aging is widely implicated in the development of BVH beyond the age of 80 due to a 50% decrease in the vestibular neuron population [1][6].
Diagnosis

Due to the idiopathic nature of BVH, diagnosing the disorder is challenging and in most cases, evades clinical diagnosis. Regardless, four methods are most effective in confirming BVH: the head impulse test, the dynamic visual acuity test, the Romberg test and ophthalmoscopy. During the head impulse test, an examiner manually rotates the patient’s head while he or she is in a sitting position. While a patient without BVH stabilizes focus on the examiner, a patient with BVH exhibits drifting eyes. Similarly, testing for dynamic visual acuity also involves oscillating the patient’s head; however, the patient must also read optotypes. Although it is normal to misread a few lines of optotypes, patients with BVH demonstrate a severe inability to accurately read them. The Romberg test assesses postural control; patients stand with their feet together, typically on a piece of foam, with their eyes closed. If the patient sways or falls, then this response indicates an abnormality in proprioception. Typically, the head impulse test, testing for dynamic visual acuity, and the Romberg test are performed together and do not require a clinical setting. Perhaps the most straightforward test is ophthalmoscopy which entails dilating the pupils and examining the back of the eyes for abnormalities [7].

Observations of daily functioning is also fruitful in diagnosing BVH. If the patient experiences dizziness during sudden movement, is unable to drive at night, or is unable to play sports, then a visit to the clinic for a potential diagnosis might be necessary [2].
Therapy

The most common treatment for BVH is compensatory therapy in which the patient exercises gaze stabilization or maintenance of posture to supplement decreased vestibular function. Given the effectiveness of cochlear implants, current research is developing vestibular prosthesis that are designed to detect head maneuvers and accordingly, stimulate ampullary nerves. Thus far, this development has been proven to work and is continuing to improve [1].

KEY TERMS

Bilateral vestibular neurectomy- A surgical procedure that cuts or removes the vestibular nerve
Meniere’s Disease- A progressive disease causing deafness, vertigo and tinnitus.
Oscillopsia- Visual disturbances in which objects appear to oscillate
Ototoxicity- Toxicity caused by chemicals or drugs to the inner ear
Optotype- A chart with rows of letters and figures that is used to test visual acuity
Proprioception- The body’s coordinated awareness of its position
Ophthalmoscopy- An instrument used to inspect the eye

References


Introduction

Hearing is one of the five senses, along with vision, taste, smell, and touch. The ears initially receive sound waves, and, through a series of processes, transmit them to the brain. In the brain, the sounds we hear are interpreted, integrated, and stored. In order to properly function, the auditory system requires a source of sound, a mechanism for transducing this sound into useful information, a mechanism for relaying the information to the brain, and pathways in the brain to process the information.

For most people, these mechanisms work well enough—but occasionally, something goes terribly wrong. According to World Health Organization, 360 million people worldwide have disabling hearing loss; a figure that amounts to 5% of the global population. Hearing loss is the decrease in hearing sensitivity to any degree. Hearing impaired people can be deaf (a condition determined by a profound or total loss of hearing in both ears) or hard of hearing (HOH). [1]

Deafness can be congenital or acquired. The distinction between acquired and congenital deafness specifies only the time that the deafness appears, but not the cause of the deafness.

In congenital cases, an individual acquires the deficiency either neonatally or postnatally. Hearing loss can be caused by various hereditary and non-hereditary genetic factors, or by certain complications during pregnancy and childbirth, including premature childbirth, hospital infections, use of forceps in childbirth, birth asphyxia (a lack of oxygen at the time of birth), inappropriate use of particular drugs during pregnancy (such as aminoglycosides, cytotoxic drugs, antimalarial drugs and diuretics), or a low birth weight. In addition, diseases affecting a pregnant mother can be transferred to the baby, and potentially cause severe jaundice in the neonatal period, which can damage the hearing nerve in a newborn infant.

Unlike congenital cases, acquired cases may lead to hearing loss at any age. Acquired cases can be caused by infectious diseases such as meningitis, measles, and mumps; chronic ear infections; and an abnormal buildup of fluid in the ear (otitis media). The following can also contribute to the onset of hearing loss: use of particular drugs, such as otoxins as well as some antibiotic and antimalarial medicines; injury to the head or ear; excessive noise, including occupational noise such as that from machinery and explosions, and recreational noise such as that from personal...
audio devices, concerts, nightclubs, bars and sporting events; ageing, in particular due to degeneration of sensory cells; and wax or other foreign bodies blocking the ear canal.[2]

Figure 1a. Word cloud from the article text by Lorrayne Isidoro

**Classification of hearing loss**

The classification of a case of hearing loss depends on what part of the auditory process fails to work properly. The main types of hearing loss are categorised as follows:

**Sensorineural hearing loss**

This type of hearing loss occurs as a result of injury to sensory cells of the cochlea (found in the inner ear) or nerve (auditory nerve) that leads the sound stimulus to the brain. The diseases of the cochlea and the auditory nerve rarely have treatment.

The use of ototoxic drugs (that damage the hearing aid) can also lead to deafness. Some of them are antibiotics, aminoglycosides and salicylates. So the self-medication should not be made under any circumstances.
Conductive hearing loss

When we say that hearing loss is by conduction, that means there is something blocking the passage of sound from the outer ear to the inner ear. This can result from damage to the eardrum, excess wax that accumulates in the ear canal, or the introduction of some material into the ear canal. Infection in the middle ear ossicles can also cause conduction deafness. This type of hearing loss can be reversed by drugs or surgery.

Mixed hearing loss

It occurs when there are problems in both the inner ear or auditory nerve and the middle or outer ears. This results in raised air- and bone-conduction thresholds, as well as an air–bone gap.

Central hearing loss

Another type of hearing loss is called central deafness. It occurs as we age and is part of a natural process of the body. Just like the eyes and the heart, the auditory system of the person also suffers wear and tear over the years. How the person treats the ears has an influence on presbycusis, the name given to aging-related hearing loss.[3]

Functional impact

One of the main impacts of hearing loss is on the individual’s ability to communicate with others. Spoken language development is often delayed in children with deafness.

Hearing loss and ear diseases such as otitis media can have a significantly adverse effect on the academic performance of children. However, when opportunities are provided for people with hearing loss to communicate, they may be able to participate on an approximately equal footing with others. The communication may be through written language or through sign language.[4]

Sign Languages

Sign language is a manner to communicate without using spoken language. Sign language employs hands shapes, orientations, and movements; facial expression; and body language. Sign Language is used mainly by people who are deaf or have hearing impairments. [5] It is worth mentioning that sign languages are not the same in the countries--it is not a universal language. Each country makes their own sign languages, similarly to how countries treat spoken languages. They are developed naturally out of groups of people interacting with each other. For example, in American Sign Language (Figure 1b), the alphabet is signed with one hand. But in British Sign Language (Figure 1c) is with two! [6]
Prevention

Half of all cases of hearing loss can be prevented through primary prevention. Some simple strategies for prevention include: immunizing children against childhood diseases, to prevent diseases that have contact with leave sequelae such as deafness; Do not take ototoxic drugs without a prescription; improving antenatal and perinatal care, including promotion of safe childbirth; reducing exposure (both occupational and recreational) to loud sounds by raising awareness about the risks; and encouraging individuals to use personal protective devices such as earplugs and noise-cancelling earphones and headphones.[7]

References

[4] Figures (Figure Ia) Isidoro-Gonçalves, Lorryane. Word cloud about deafness and hearing loss. Word cloud from the article text. Created on 01/16
Meniere’s Disease: A Summary
Christian Gonzalez

Introduction
In 1861, French physician Prosperi Meniere spoke of the main symptoms of a disease that would later be named after him. Characterized by episodes of vertigo, tinnitus, and hearing loss, Meniere’s Disease is a disorder of the inner ear which affects primarily one ear but may later spread to the other. Symptoms of Meniere’s Disease include a ringing in the ears and a feeling of intense dizziness. Episodes are relapsing, and there is currently no known cause. These relapsing episodes can last anywhere from 20 minutes to several hours, which allows for some normality in the life of a patient [1]. Unfortunately, the constant ringing and hearing loss that a patient experiences is often permanent. Typically, the severity of the disease can lessen over time, but increasingly pronounced hearing loss often results from the progression of the disease. It is a rare disease, with only about 615,000 known cases in the United States annually [2]. Overall, 50% of cases become bilateral, affecting both ears, but if bilaterality is not developed within approximately five years after the onset of the condition, then the probability of a patient being afflicted by bilaterality drops substantially [3].

Overview and Symptoms
The symptoms of Meniere’s Disease generally vary minimally between cases. At the onset of the disorder, a patient will experience more episodes of vertigo (spinning sensation), which last anywhere from approximately 20 minutes to upwards of 24 hours and can result in nausea and vomiting. Additionally, temporary hearing loss is a common problem experienced by patients with the disease. In some cases, this hearing loss may become permanent, especially during the latter stages of the disease. Tinnitus (ringing in the ear) is also another common sign of the disorder, which can provide a great deal of discomfort to the patient with the disorder. Aural Fullness (ear pressure) is also experienced and pressure can be felt in either of the affected ears or on the sides of the head. In short, Meniere’s Disease results in a somewhat narrow range of hearing and ear-related symptoms including vertigo, tinnitus, hearing loss, imbalance, nausea, ear pressure [4].

Causes
There is currently no known cause for Meniere’s Disease. As a result, the disorder is known as an idiopathic (unknown cause) disorder [5]. Still, there are a number of potential causes...
that are being investigated currently. Some of these factors include blood vessel constriction, viral infections, and autoimmune reactions. Additional factors that have been speculated to result in Meniere’s Disease include allergies, genetic predispositions, vestibular migraines, head trauma, and abnormal fluid drainage. Since no single factor has been determined to cause the condition, many physicians contribute the onset of the disease to a combination of the factors that are thought to be involved in the onset of the condition [4].

**Diagnosis**

There are several tests which a doctor may use on a patient in order to determine whether or not they have Meniere’s Disease. Some of the most common of these methods that are used include: audiometry, computed tomography, magnetic resonance imaging, electronystagmography (rotational testing), electrocochleography, and vestibular evoked myogenic potential (VEMP). Additionally, in order to determine if a patient has definite or probable Meniere’s Disease, doctors require the following symptoms from a patient [4]:

- Two episodes of vertigo, each lasting 20 minutes or longer but not longer than 24 hours
- Hearing loss verified by a hearing test
- Tinnitus or a feeling of fullness in your ear
- Exclusion of other known causes of these problems

**Pathophysiology**

The pathology of Meniere’s Disease is poorly understood due to the absence of an established cause. However, there are many inflammatory factors that can lead to what is known as endolymphatic hydrops. This condition is closely associated with Meniere’s Disease, and it is the reason why Meniere’s Disease is sometimes referred to as idiopathic endolymphatic hydrops. The pathology of the disease can be broken down into three primary stages. During the first stage of the disease, a patient will succumb to unpredictable attacks of vertigo. This stage is also the defining feature of the disease, as it will affect patients the most. Hearing loss may also accompany the episodes of vertigo, as well as the feeling of fullness in the ears that are affected. The second stage of Meniere’s Disease also involves attacks of vertigo but to a lesser extent; however, patients may also begin to have difficulty with balance, and pronounced tinnitus may develop. The third and last stage results in increased hearing loss, causing permanent ear damage. In contrast, the attacks of vertigo lessen and often disappear entirely, although tinnitus and difficulty with balance continues [2].
Treatment

There are a plethora of methods that can treat Meniere’s Disease. Patients can benefit from abstaining from alcohol and consuming low salt diets, and diuretics can be prescribed to manage some of the symptoms and frequency of the symptoms accompanying Meniere’s Disease. Antidepressants and sedatives are also useful in the treatment process, as well as antiemetics and antivert. Several surgeries may benefit patients also such as endolymphatic sac surgery and vestibular neurectomy. Intra-tympanic steroid injections and Intra-tympanic gentamicin (chemical labyrinthectomy) is also helpful in treatments as well.

Advocacy and Awareness

If you would like to get involved in advocacy efforts or know more information about how you can help patients living with Meniere's Disease through increasing public awareness of the disorder, please visit the organizations listed below.
Meniere’s Society

Vestibular Disorders Association
http://vestibular.org/Advocate

Figure 1: Comparison of between a healthy inner ear and one affected by Meniere’s disease [5].
**KEY TERMS**

**Prosper Meniere**-  French physician known for first identifying Meniere’s Disease  
**Vertigo**-  Perceived sensation of external objects spinning when they are in fact stationary  
**Tinnitus**-  Abnormal ringing in the ears not caused by an external source  
**Aural fullness**-  Feeling of pressure or fullness in the ears  
**Idiopathic**-  Related to a disease without a known cause  
**Vestibular migraine**-  Migraine associated vertigo that results in dizziness  
**Audiometry**-  Test for determining hearing range and sensitivity  
**Computed tomography**-  Imaging technique that uses X-rays to take photos of organs and other body parts  
**Magnetic resonance imaging**-  Imaging technique that uses magnetic fields to take photos of organs and other body parts  
**Electronystagmography**-  Diagnostic technique used to study involuntary eye movements  
**Electrocochleography**-  Diagnostic technique used to study electrical potentials in the ear in response to sound stimulation  
**Vestibular evoked myogenic potential**-  Diagnostic technique used to study the otolith of the inner ear and the vestibular system  
**Endolymphatic hydrops**-  Disease of the inner ear that results in vertigo  
**Antiemetics**-  Class of drugs taken to prevent nausea and vomiting  
**Antivert (Meclizine)**-  Antihistamine used to treat vertigo  
**Vestibular neurectomy**-  Surgery to improve vertigo through cutting the vestibular nerve  
**Gentamicin**-  Antibiotic used to treat bacterial infections  

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**References**


Research Methods: Human Experimentation

Introduction

When conducted in accordance with ethical guidelines designed to safeguard the health and well-being of participants, human experimentation can provide valuable insights into the inner workings of the human brain. In both basic research and clinical trials, human experiments have offered valuable information to allow researchers to both better understand and treat human disease.

Ethical Guidelines

Before understanding exactly how human experimentation is conducted, it is first important to recognize when it is appropriate to use. Unlike in research with model organisms (see Issue 2) or Cell Culture (see Issue 5), human research must follow very strict ethical guidelines. In addition to the common-sense guidelines, such as the banning of both experimental ablation (lesioning of tissue to observe its effects on physiology), there are some less intuitive guidelines that can be remembered with the following mnemonic: I Don't Want Dark Coffee, Dude*.

I - Informed Consent: Informed consent, often verified in the form of a waiver, involves informing the participants that they will be participants in the study. In any sort of study, obtaining informed consent is essential in order to minimize patient stress and offer them the opportunity to opt out of the study. Perhaps the most egregious violation of this rule in biological research was the use of the cells of Henrietta Lacks without her consent. While this allowed for tremendous advancement in our understanding of cancer, the fact that she was neither informed nor reimbursed for her contributions to science still is the center of an intense ethical debate.

Don't - Do No Harm: The credo “Do No Harm” applies to human experimentation as well as medicine. Anything more than temporary discomfort is to be avoided at all costs in
human experiments, and researchers are expected to make every effort to minimize patient discomfort in experiments during which they are likely to experience it.

**Want - Withdrawal:** Should a test subject feel uncomfortable at any point during a study, he or she has the right to exit the study. Furthermore, participants retain the right to withdraw their data as well. This guideline ensures that participants experience no excessive discomfort.

**Dark - Deception:** Any studies using human participants should not use any significant deception. Slight deception, such as giving participants in a clinical trial a placebo, is appropriate. However, deception that is likely to cause undue stress is entirely inappropriate in research. The Milgram Shock Experiment is one famous experiment in which inappropriate levels of deception were used.

**Coffee - Confidentiality:** When conducting experiments on human subjects, no published results should include identifying information. This ensures not only the security of the identities of the test subjects but also their psychological well being, as many people may feel stress if they discovered that their data was online. Case studies often result in difficulties, as they are centered around one individual. To follow this guideline, case studies often omit certain identifying information, and generally refer to patients by their initials (as in the case of Patient H.M.).

**Dude - Debriefing:** After completing an experiment, researchers are typically expected to explain the true aims and results of the study to the participants of the study. This ensures that participants will understand the study in which they participated.

In addition to considering these ethical guidelines, researchers hoping to conduct human experimentations must often gain pre-approval from their research. This guideline was codified in the 1974 National Research Act, which was prompted by ethical abuses in research, the most famous of which being the Tuskegee Syphilis Study. This act mandated that Institutional Review Boards be established. Institutional Review Boards are organizations that act to regulate human research and ensure that all ethical guidelines are followed. The three main factors they consider when deciding whether or not to approve an experiment are “Respect to persons, beneficence, and justice” [1].

**Applications of Human Experimentation**

Even within the ethical guidelines of human experimentation, researchers have a significant amount of freedom to conduct research - both basic research and clinical research rely heavily on human experimentation. Described below are some examples of how modern researchers are using ethical human experimentation in order to explore the auditory system:
Basic Research: Auditory Hallucinations and the Schizophrenic Brain [2]

A study led by Christian Gaser and Igor Nenadic entitled *Neuroanatomy of ‘Hearing Voices’: A Frontotemporal Brain Structural Abnormality Associated with Auditory Hallucinations in Schizophrenia* explores the physiological basis of auditory hallucinations in schizophrenia. In this study, the research team compared the brains of schizophrenic patients and those of healthy controls in order to identify the structural basis of auditory hallucinations. They found that structural deformities in multiple brain regions, including the Primary Auditory Cortex, are highly correlated to the severity of auditory hallucinations as scored by trained raters.

In order to follow the ethical guidelines outlined above, the research team obtained IRB Approval and informed consent from all patients before starting this experiment. As this was an observational study, meaning that it did not involve the manipulation of any variables, many of the other experimental ethics guidelines outlined above did not apply to this study.

When considering the objectives of their study, it is clear that human experimentation was necessary. As psychiatric disorders cannot be faithfully modeled with model organisms or in a petri dish - and even if they could, neither animals nor cells would be able to report experiencing hallucinations - the use of human experimentation allows for unparalleled insight into the functioning of the human mind. By understanding disorders in humans, researchers can develop better diagnostic tools and personalized treatment options for people with specific biological abnormalities.

Clinical Trials for Cochlear Implants [3]

When conducting clinical trials in order to test medications, one additional factor in experimental design must be taken into consideration: Double-Blind studies. When testing medications, it is often to use a group receiving a placebo as a control group to determine whether the medication is truly effective itself or it causes improvements simply due to the subject’s expectations of the medication’s effectiveness. In a double-blind study, neither patients nor doctors know what condition the patient is in; however, an independent research team does. In certain cases, researchers can use this study format to compare a new and existing drug.

While a double-blind design was not used in the clinical trial *Cochlear Implantation in Cases of Single-Sided Deafness (CI in SSD)*, which is currently in progress, it is still valuable to understand exactly how human experimentation can be used in studies on the auditory and vestibular systems. The researchers in this study hope to investigate exactly how the use of a cochlear implant affects patients with single-sided deafness. The researchers will compare the cochlear implants to existing treatment options and people without cochlear implants to observe their effects on patient hearing.
Overall, human experimentation provides substantial benefits to researchers despite its restrictive ethical guidelines and possibilities of error, as it offers invaluable data about humans that cannot be obtained by cell culture or model organisms. After all, the study of the human nervous system calls for direct investigation of our specific species. Perhaps one of the major challenges we face in the coming years is in the development of new experimental techniques to optimize the advantages of human experimentation whilst keeping to ethical regulations and controlling for more variables.

References


Research Summary: The Effects of Music Listening on Pain and Stress in the Daily Life of Patients with Fibromyalgia Syndrome

Meenu Johnkutty and Shreyas Parab

Introduction

Let’s face it: music is everywhere in our lives. Whether it be jamming out to NSync™ in the car or listening to Taylor Swift after a tough breakup, music plays a tremendous role in alleviating stress. But, could music actually ameliorate pain for patients suffering from fibromyalgia, a condition characterized by chronic pain? Researchers from Germany and the United Kingdom may have an answer. But first, let’s define pain and what it means for patients with fibromyalgia.

So, what is pain? Pain involves several mechanisms occurring in the central and peripheral nervous systems. Pain messages are transmitted via impulses on C fibers, which are small unmyelinated nerves, from the spinal cord to several brain structures such as the thalamus and the cerebral cortex. Pain comes in two different forms - acute and chronic. Acute pain is a short-term sensation we feel when we step on a thumbtack (or a Lego)--a quick feeling of pain that might evoke a small shriek. Chronic pain, however, persists for three or more months and stems from injury or disease to nervous structure that can leave permanent effects on the
functionality of the nervous system. Pain messages are constantly delivered via C fibers, leaving no relief for chronic pain sufferers (Brain Facts, 2016).

An affliction of the musculoskeletal system, fibromyalgia is a disorder characterized by widespread chronic pain in which individuals can experience searing flashes of pain that prevent many patients from leading normal lives. Although its exact cause has yet to be identified, fibromyalgia causes patients to send strong and frequent impulses via C fibers to various parts of the human body. Many fibromyalgia patients suffer from several symptoms: fatigue as their pain prevents comfortable rest, inability to focus on tasks because of “hot flashes” of pain, and even difficulties developing cognitive abilities due to sporadic spasms. No cure for fibromyalgia has been found, as its cause has yet to be fully identified, so much of the treatment available focuses on minimizing symptoms and improving the living condition of those afflicted.

Researchers from Germany and the United Kingdom have come up with a promising link between listening to music and alleviating pain. The researchers hypothesized that the pain-reducing effect of music would be mediated by a reduction of the activity of stress-related systems in the body. The researchers isolated the HPA axis, a system consisting of the hypothalamus, pituitary gland, and the adrenal cortex, as possible mediator. This specific system is a major stress-responsive system in the brain. Prior research has shown that a downregulation of activity in this axis leads to a subsequent lowering of concentrations of cortisol, a stress hormone. Since the mechanisms underlying music listening and the HPA axis in chronic pain have yet to be understood, the researchers designed an experiment to investigate music’s possible beneficial effects.

**Experimental Design**

The experiment consisted of a total of 30 women at the Fibromyalgia Research who had given consent to the study and did not have any glaring abnormalities which might affect the results in any form. Women were intentionally chosen over men because fibromyalgia patients are commonly women. After satisfying eligibility criteria, the women were examined for 14 consecutive days. The women received an iPod touch on which they were required to complete six daily assignments. The assessments measured music-listening behavior, pain, and subjective stress levels. Each day the women were required to listen to music at six different times of the day and then complete a set of questions after each assessment. Then, they were asked to collect their saliva in pre-labeled tubes in order to analyze for salivary cortisol levels, biological markers for increased levels of stress.

**Results**

Prior to the commencement of the experiment, the women reported having suffered from fibromyalgia syndrome for a total of 120 ±86 months. The patients had listened to music for a total
of 2.0 ±2.2 hrs. A majority of the women reported that the music they listened to was “positive” and “high in arousal.” The reasons most commonly stated for music listening prior to the experiment were: ‘relaxation’ (48.8%), ‘distraction’ (34.5%), ‘activation’ (25.8%), and ‘reducing boredom’ (12.3%).

The overall mean pain intensity, analyzed from the women’s assessments and rated on a scale ranging from 0 to 100, was 47.5 ± 25.0. On a scale from 0 to 5, patients rated a moderate level of perceived control over pain: 2.82 ± 1.1. Perceived stress was rated with a mean of 1.5 ± 1.0 on a scale from 0 to 4. The assessments revealed that music listening was not linked to any changes in perceived pain levels. Those who initially stated that they listened to music for relaxation and activation felt increased levels of control over pain. Additionally, there was no decrease in the levels of subjective stress levels measured in the assessments. Music listening was also not linked to any reductions in cortisol levels.

Discussion

The researchers found a positive link between music listening and how the patients coped with stress in their daily lives. Women who listened to music more often reported having felt this sense of control. The researchers did not find any reduction in subjective stress, nor any biological evidence to support downregulation of stress-responsive systems.

Conclusion

Though listening to music did not translate to any physiological effects among the women tested, it still translated to increased levels of positive pain control. Even though music may not trigger anything physical, per se, in the body, it does allow for patients with fibromyalgia syndrome to feel a semblance of control over their pain.

References


Anosognosia: Is Vestibular Stimulation Ethical?

Mallika Reddy Pajjuri

Introduction

Anosognosia, a severe symptom associated with mental illness, is the inability of a patient to perceive his or her own neurological disorder. Caused by the deterioration of the frontal lobe by illnesses such as dementia and bipolar disorder, anosognosia is highly detrimental to society’s well-being and upkeep since anosognosia sufferers lack insight, potentially equating to disruption or impediment to the safety of a community. Even though prescription medications are available to alleviate this condition, researchers have turned towards utilizing vestibular stimulation by means of cold water caloric irrigation in order to vastly, if not completely, alter the presence of the symptom. However, this process does not aid the eradication of the neurological disorders themselves, and this inevitably results in the patient becoming aware of his or her condition. This highly controversial practice has been subject to scrutiny by various external sources trying to answer one universal question: Would it be better to corrupt the innocence of a patient or to steer society into harm’s way?

Anosognosia

In 1914, French neurologist Joseph François Babinski was accredited with the coinage of the term anosognosia, combining three Greek word stems to create this comprehensive word.
With “a” meaning without, “nosos” meaning disease, and “gnosis” meaning knowledge, the term anosognosia had been defined as the lack of knowledge regarding one’s own disease [1]. Soon after Babinski developed the term, discussions erupted over its supposed symptom: Is anosognosia merely denial of one’s disease? However, this is not at all the case since anosognosia sufferers do actually experience alterations of their neurons in the right hemisphere’s frontal lobe and parietal lobe. Denial involves the rejection of negatively associated events, ideas, thoughts, and items in order to alleviate the emotional weight something may carry. Anosognosia, on the other hand, involves the unintentional rejection of a patient’s own disorder due to neuronal damage.

Despite being a relatively unknown term, understanding Anosognosia is extremely integral to successfully appreciating the plights of victims of neurological disease: Anosognosia is reported in fifty percent of stroke victims and eighty-one percent of progressive dementia patients [2]. In order to diagnose this symptom, health practitioners utilize the four leveled self-awareness rating scale, determining the severity of the patient’s symptoms. This scale ranges from a rating of 1, used in the case that a patient easily recognizes his or her own memory loss, to 4, used in the case that a patient is agitated and annoyed while trying to explain that he or she does not have a memory problem. However, it is often difficult to diagnose a patient because of the nebulous difference between denial and anosognosia. Thus, practitioners look for alternative diagnosis markers, such as confabulation, in order to recognize true anosognosia [1].

Confabulation occurs when a response made by a patient is false due to misremembering rather than being on purpose. For example, a patient may state that Practitioners will ultimately call for close friends and family to aid the diagnosis process: they will determine whether or not the facts stated by the patient are veracious, and if the facts are veracious, then the patient is ultimately characterized as a patient with anosognosia symptoms.

**Vestibular Stimulation**

Vestibular stimulation is the process utilized in treating many—if not most—neurological disorders with no physiological explanation [1]. There are two main vestibular stimulation processes, caloric and galvanic stimulation, and both can cater to a wide variety of neurological disorders [4]. Caloric vestibular stimulation is more commonly acclaimed for the remission of a variety of cognitive functions, manipulating another person by physical means by using cold or hot water or air in order to stimulate the external auditory canal [1]. Galvanic vestibular stimulation, on the other hand, requires the usage of low voltage electric current in order to stimulate the same nerve [5]. Regardless of the process, vestibular stimulation can aid the development of infants, the remission of various cognitive functions, and, in the case of anosognosia, the remission of a neurological disorder’s symptoms. In both types of stimulation, an external person is entrusted with the ability to manipulate the technology accountable for sending electric current, water, or air.
What’s the Problem?

Vestibular stimulation is becoming increasingly popular amongst vastly different groups of people, from parents to researchers. As it has gained notoriety for its simplicity and effectiveness, its usage has become universal; however, it has not been integrated completely to treat symptoms of neurological disorders due to its ethical limitations. Some people regard it as the Holy Grail of medical treatments: Since it is quick and relatively inexpensive, some believe that it will revolutionize the treatments utilized to cure symptoms of neurological disorders. However, others believe that it comes at the expense of morality: when treating neurological disorders, the eradication of anosognosia is inevitable, making the patient’s awareness of their own disorder entirely dependent on the choice of another person. This entails human control of another human, which has implications that may very well be condemned by the general public [5]. As the scientific community makes its decision on whether or not to utilize vestibular stimulation to treat anosognosia, we must take into account the positives and negatives on this highly controversial procedure.

References


Vitreous Humor: The Official Satire Column of the IYNA

IYNA Satire Team

Vestibular System Not Evolved Balance Academics, Social Life, and Sleep

According to a recent paper, scientists have discovered that the human vestibular system has not adapted to balance academics, social life, and sleep. After reading last year’s revolutionary study which revealed that the vestibular system does NOT balance one’s checkbook, the research team responsible embarked on a quest to determine what else, exactly, the vestibular system does not do for humanity.

“We discovered the inability of the vestibular system to balance the United States budget and formulas for chemical reactions. Furthermore, we found no evidence of its role in teenage neurodevelopment or getting into Stanford University, to the dismay of literally everyone on College Confidential.”
“Well, this is kind of expected,” the research team replied to disgruntled high school students. “Unlike some of you, the vestibular system is not evolved to manage a schedule 29.4 times its size.”

“What are you looking at me for?” the semicircular canal asked in response to these scathing criticisms. “The frontal lobe was the one who decided to take 8 APs, run five clubs, and play a varsity sport in the same year. Also, it’s the stupid pituitary gland that keeps secreting melatonin. If we didn’t have that around, humans could stay up all night.” In an interesting twist, the semicircular canal concluded by noting that “I’m not even sentient. You’re just anthropomorphizing me to externalize your own thoughts.”
Local Student Mishears Neuroanatomy Professor for Entire Semester, Believes he is Discussing “Areas of the Brian”

Today we turn to an unforeseen tragedy that has recently transpired in this locality. Fred Smith, local student attending university, has reportedly misheard his professor for the entire first semester of his “Principles of Neuroanatomy” course. Sources confirm that the student believed, for all 18 weeks of the semester, that the professor was lecturing about “Brian” and the “Serena Court Test”. Those close to Smith explain that when his class reached the limbic system, he was remarkably confused about hippopotami and the single hit gyrus.

In a special visitation to the local hospital, he was especially perplexed. A middle-aged, serious looking woman in a white lab coat spent several hours talking about some kind of animal-letter copier. Apparently the hospital had spent millions of dollars of college tuition money on machines used to fax various PETs, primarily CATs for some reason. Being a dog person, Fred was justifiably offended.

Smith’s problems culminated with a fortuitous encounter between Smith and local hearing specialist Mark Johnson. Earlier this year, Johnson was at a local coffee shop ordering a coffee when Smith inadvertently bumped into Johnson and spilled Johnson’s coffee all over his generic t-shirt. Smith was profusely apologetic, and, after offering to buy Johnson another coffee, began having some dumb conversation about sports teams or whatever. Soon enough, one thing led to another, and Smith began telling Johnson about his hearing issues. Johnson took him back to his office and took a closer look; in Johnson’s scholarly opinion, Smith’s ears were “pretty jacked up.”

Mr. Smith’s future is, however, looking bright. Following a detailed CAT scan, during which lab technicians were forced to restrain him with large quantities of duct tape following his repeated angry desires for a DOG scan, whatever that is, Dr. Johnson discovered that Fred was suffering from an abnormally large buildup of earwax due to poor personal hygiene. At press time, Johnson stated that Smith will be undergoing highly invasive surgery next Thursday as his cranium is entirely removed in order to retrieve the wax, which will be sold at auction to the highest bidder.
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