

Is the cause of RBD neurological or psychological?

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Abstract: RBD stands for Rapid Eye Movement Disorder and is a sleep disorder that happens during your REM (Rapid Eye Movement) stage of sleep. People often associate the cause of RBD with dreams because people dream during the REM stage of sleep, which is also when RBD tends to happen as well. It may affect a small fraction of the general population, but that is still a fairly large amount of people in the world who suffer from RBD. Previous research by Michel Jouvet proved that RBD in cats were caused by brain lesions, and two scientists discovered that brain lesions can suppress negative emotions. From these two discoveries I have decided to research whether or not RBD can be categorized as something to do with psychological behaviour or neurological behaviour. I have modeled two experiments and several possibilities that one may receive in which I will have a certain reasoning for each.

Keywords: RBD; Rapid Eye Movement Sleep Behavior Disorder; Brain Lesions; Neurology; Psychology

1. Introduction

RBD (Rapid Eye Movement Sleep Behaviour Disorder) is categorized as parasomnia (Howell & Schenck, 2020). Parasomnias are sleep disorders that interrupt your sleep through physical or verbal movement (Parasomnias & Disruptive Sleep Disorders, 2017) and happen in any stage of sleep. Dreaming happens in the REM stage of sleep and occurs for about 20 mins 3-6 times per night (What does it mean when we dream?, 2018). REM stands for Rapid Eye Movement and is the last stage of sleep. This stage repeats multiple times through the night and occupies 20%-25% of an adult's sleep and 50% of a child's (Leonard, 2017). In fact, most dreams occur in this stage of sleep (Leonard, 2017). In REM sleep your eyes move quickly in different directions (Leonard, 2017), your blood pressure rises, breathing becomes shallow and irregular, and your heart rate increases (What does it mean when we dream?, 2018). During the REM stage of sleep, people often feel temporary paralysis because the brain tells the nerves in someone's body to stop moving for a moment (Leonard, 2017). The temporary paralysis is also known as atonia (Leonard, 2017). During RBD there is a loss of atonia, allowing the body to create movement that interrupts your sleep verbally or physically (REM sleep behavior disorder, 2018). Although the exact cause of RBD is unknown, many people have stated that RBD is caused by people acting out their dreams. This can be associated with atonia and dreaming. Atonia is thought to be what paralyzes us during our dreams to prevent us from injuring ourselves (Leonard, 2017), and whether they remember it or not, people do dream, and they dream about 3-6 times per night (Nichols, 2018). Being unable to remember dreams may be a part of the reason why it is so hard to pinpoint the exact cause of RBD.

RBD affects 0.38%-2.1% of the general population (Högl & Stefani, 2016), and in which there is a male to female ratio of 9:1, but female cases are often underdiagnosed (Howell & Schenck, 2020) (See Figure 1). Cases in seniors are often a predictor for neurodegenerative disorders with about 33%-50% of cases leading to Parkinson's Disease, 80%-95% leading to multiple system atrophy, and 80% leading to dementia with Lewy bodies (Howell & Schenck, 2020). Cases in adults <40 years old are often caused by antidepressant medication and narcolepsy (Howell & Schenck, 2020), with 6% of RBD cases associated with antidepressant medication (TheRecoveryVillage, 2020). Cases in children are very rare, but are often caused by antidepressant medications, brain stem tumours, neuropsychiatric disorders and narcolepsy type 1 (Howell & Schenck, 2020). Narcolepsy is a chronic sleep disorder that has sudden attacks of sleep during the daytime and poor sleep during nighttime (Narcolepsy, 2020). This is due to muscles in the body suddenly going weak (called cataplexy), causing the patient to collapse (Davis, 2020). Type 1 narcolepsy is with cataplexy and type 2 is without (Narcolepsy, 2019). Narcolepsy and RBD may be connected as both having some part to do with sleeping and some part to do with muscles not functioning properly.

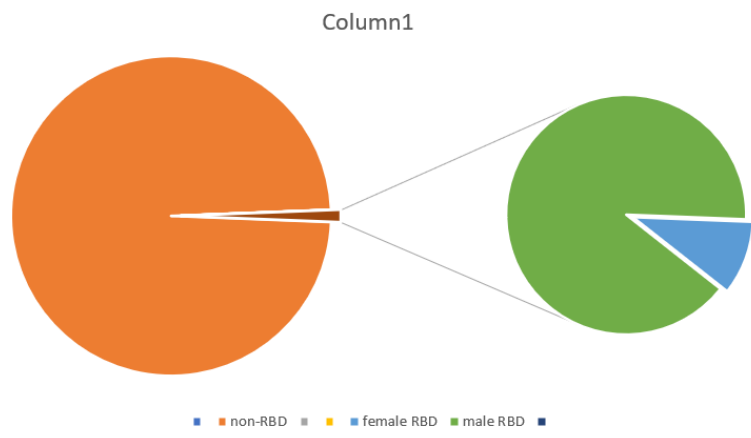


Figure 1: Pie chart of female and male RBD cases to non-RBD cases of general population. Orange represents the ~98% non-RBD people, red represents the ~2% of people diagnosed with RBD. In the ~2% RBD patients, 10% of them are women and 90% of them are men.

Conclusions have previously been drawn about dreams and RBD being connected by the person acting out their vivid dreams (REM sleep behavior disorder, 2018), but my research is pushing to prove that there is a scientific reason to it. I am looking at whether the cause of RBD is neurological or psychological. The findings of this experiment can possibly help lead scientists towards a cure or treatment to this disorder. If the result is that RBD is a neurological disorder, scientists could help find treatment that might be similar to the ones used in neurological diseases like antioxidants (Kiaei, 2013), and if the result is that RBD is a psychological disorder, scientists may be able to treat it with medicine or therapy. If neither of my conclusions are what the results will show, then more research questions and conclusions can be made on this topic. I want to push forward this type research because RBD can cause serious injuries to the person or the person they are sharing the bed with. A group of scientists had conducted a survey on the rate of injuries with RBD and the results were 55% reported an injury, with 37.8% to self and 16.7% to the bed partner. 11.3% had visible/recognizable injuries requiring medical care or hospitalization, in which 4% of people had subdural hematomas (McCarter, et al., 2015). To prevent these types of injuries, a scientific reason can be found and research for treatments can be made.

As of now, little is known about this subject, but what we do know is that RBD patients act out their vivid/graphic dreams, RBD may be able to predict neurodegenerative diseases (Zhang, et al., 2020), RBD in cats are caused by brain lesions (Jouvet, 1967), and brain lesions may suppress emotions. RBD and dreams have been said to be connected by the person acting out vivid dreams (REM sleep behavior disorder, 2018), and I am looking to further prove that by conducting research to find out whether the dreams are caused by brain lesions suppressing emotions or whether RBD can be categorized as a type of neurological disorder. Throughout this paper I will discuss the previous research done on this topic, the experiments that I set up to find the answers to my questions, the potential outcomes and the meanings of each potential outcome.

2. Research Method and Design

It is hard to completely determine what types of nightmares/bad dreams cause RBD because 95% of people do not actually remember their dreams (What does it mean when we dream?, 2018). Though there has been some research done, the results have almost always described RBD as a parasomnia where you act out graphic/unpleasant dreams vocally or physically. However, in the 1960s-1970s, Michel Jouvet had discovered that RBD in cats were caused by brain lesions (Rapid eye movement sleep behavior disorder, 2020), and he may have a point. Brain lesions are abnormal growths, which are not brain tissue, shown on a brain-scan (Brain Lesions, 2018). Mario F. Mendez and Leila Parand discovered that a 63-year old male, who attempted murder after hearing voices in his head, was able to gain 'mirth and happiness' after suffering a gunshot wound to his head. They concluded that "positive emotions such as mirth and happiness can emerge from brain lesions and persist" (Mendez & Parand, 2020). This may suggest that the brain lesion that was found in the cat suppressed positive emotions and triggered the unpleasant dreams/nightmares which may have caused the RBD. Others have also found that RBD can predict neurodegenerative diseases (synucleinopathy and non-synucleinopathy) such as Alzheimer's Disease, Parkinson's Disease and other dementias (Zhang, et al., 2020). "Synucleinopathies are a group of neurodegenerative disorders in which the protein alpha-synuclein accumulates abnormally to form inclusions in the cell body" (Silber, St. Louis, & Boeve, 2017). Alpha-synuclein is a protein that is found in neural tissue and is found in different cortexes of the brain (Iwai, et al., 1995). This analysis may suggest that RBD is similar to neurodegenerative diseases therefore slightly contradicting the statement that RBD is caused by dreams.

A research experiment has previously been done by Michel Jouvet on a cat to prove that brain lesions can cause RBD (Rapid eye movement sleep behavior disorder, 2020). Another investigation had been conducted by Mario F. Mendez and Leila Parand to discover that brain lesions suppress emotions (Mendez & Parand, 2020). Based on these two discoveries, I conclude that brain lesions may have suppressed the positive emotions in RBD, triggering the unpleasant dreams. However, I have not seen any other research extending Michel's discovery which means this connection could possibly be a move in the wrong direction. Another discovery is that RBD can predict synucleinopathy and non-synucleinopathy neurodegenerative diseases (Zhang, et al., 2020). These two statements both point possibly new ideas and bringing these ideas in can help find/point us towards the cause of RBD. Here, I am proposing two experiments that may be of use to unveil this mystery.

2.1. Design of Study 1

For the research, I will take two groups of 20 people (group 1 and group 2). In group 1, half of the people have been diagnosed with RBD, and the other half has not. Each of those smaller groups will have 5 female and 5 males. This step is to ensure that we have equal cases for each gender and create equality. For this experiment we will use a CT scan or MRI scan to scan the brain when they are in the REM stage of

sleep. In the RBD patients, we will look for brain lesions, especially in the limbic brain. The limbic brain is the section of your brain that controls emotions (Seladi-Schulman, 2018). The brain lesions will appear as dark or light spots that do not look like normal brain tissue (Brain Lesions, 2018) (See Figure 2 and 3). In the non-RBD patients, we look at the scans and compare and find the difference, especially in the limbic brain. The desired result of this experiment is that we will be able to find that the brain scan in the RBD patient has an abnormality (brain lesion) in the limbic brain, and the non-RBD patients that have no abnormalities on the limbic brain.

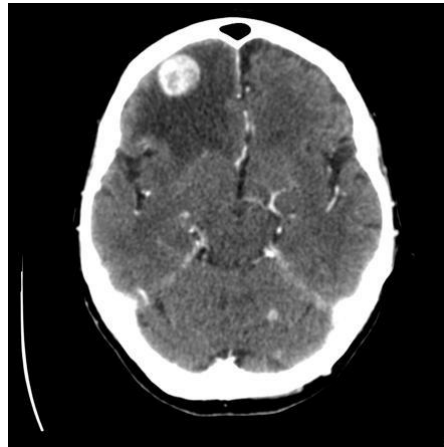


Figure 2: Brain Lesion on a CT scan. White mass at the front of the top left is the brain lesion.

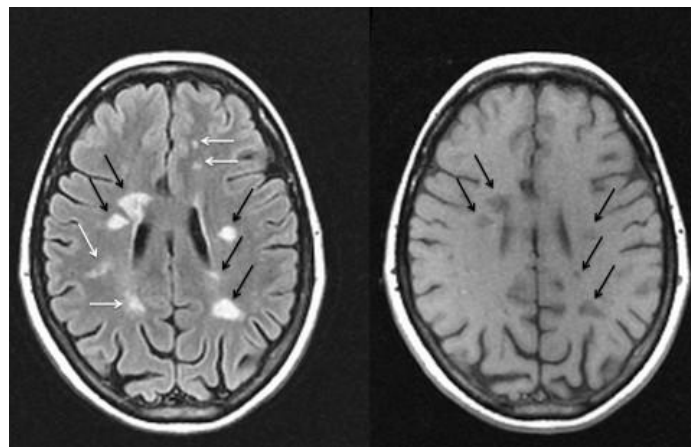


Figure 3: Brain Lesion in an MRI patient on an MRI scan. White and black arrows point at brain lesions.

2.2. Design of Study 2

In group 2, about 7 people will be RBD patients, 7 will be neurodegenerative disorder patients, and about 7 that are not RBD patients. I will also have 3-4 females and 3-4 males in each mini group. In this experiment, an MRI will be used to scan their brain. A CT scan is not recommended in this situation because for this experiment we need to see detailed brain pathways. To get that, an MRI must be used because they give a more detailed look at the brain (Fletcher, 2019). After scanning the brain, we compare the brain scans and look for the similarities between RBD and neurodegenerative disorder patients and look for the differences with the non RBD patients. This will help us find out whether RBD has a defined connection to

neurodegenerative disorders or not. The desired outcome for this experiment is that we will find similarities between the RBD patients and neurodegenerative disorder patients which are different from the non-RBD and non-neurodegenerative disorder patients.

Inevitably there will be outliers due to the uneven statistics but by increasing the number of people in the experiment we can hopefully rule out the outlier and move forward with the experiment. By ruling out the outlier, we keep it on the side and use it if any other questions rise about the experiment.

3. Possible outcomes

3.1. If we receive desired result of Study 1

If we receive the desired result, it could mean that brain lesions do suppress certain emotions. Especially in this case, where we have RBD patients acting out their dreams which are upsetting more often than not. This conclusion was made due to a research that was conducted by two scientists who discovered that positive emotions can be produced due to brain lesions (Mendez & Parand, 2020). Depending on where the brain lesion is, it could possibly produce negative emotions too. RBD is connected to this because an investigation conducted by Michel Jouvet proved that RBD in cats were caused by brain lesions. Though cats are quite different from humans, we are both mammals, adding that experiments can be conducted on cats which can and may produce the same results on humans. The treatment for this result would be either brain lesion surgery removal, radiation treatment or medicine that may help bring back the positive emotions during sleep. However, each of these treatments have side effects, and more research that needs to be properly done before actually prescribing the medicine. The immediate side effects of brain lesion surgical removal include swelling of the brain, dizziness, seizures, weakness in the body, etc. (Recovering from brain tumour surgery, 2019). Long term side effects include inability to walk properly, trouble concentrating, trouble memorizing things, being unable to speak properly, etc. (Recovering from brain tumour surgery, 2019). The immediate side effects of brain lesion radiation removal are fatigue, you may lose some hair, your hearing might feel muffled, your skin may be irritated, etc. (OncoLinkTeam, 2019). Long term effects are developing cancer (very low chance), some damage to healthy brain tissue, if the brain lesion is in a large area of the brain some brain function could be lost, etc. (OncoLinkTeam, 2019). As I am not sure of what medicine may be needed to treat this condition, I cannot describe the side effects of the medicine. Hopefully in the future there will be more research done to see which medicine can help relieve RBD.

3.1.2. If we do not receive desired outcome of Study 1 pt.1

If both groups of brain scans show that there are no brain lesions or masses in the limbic brain, then this would mean that this conclusion is incorrect. This would mean that there are no brain lesions in the limbic brain during RBD and that RBD is not a psychological (emotion) problem. This would allow more research to be done to open up this disorder more.

3.1.3. If we do not receive desired outcome of Study 1 pt.2

If the brain scans show the opposite of the desired results, then it could possibly mean that the RBD patients has a section of their brain that degenerates over time, now making this conclusion into a neurological one. My research will not go into detail for this conclusion, but I hope in the future this idea may be used to further improve accuracy of treatment for RBD.

3.2. If we receive desired outcome of Study 2

If we do receive the desired result, it could mean that RBD has some sort of connection to neurodegenerative disease. We may even be able to go so far as to say that RBD is a neurodegenerative

disease. Previously, it is found that RBD can predict which patients will end up with a neurodegenerative disorder as they age (Zhang, et al., 2020). Most likely, we will look in the limbic brain (where emotion and memory are controlled) for a sign, but we can also look at the cerebellum (where motor skills are controlled) because in neurodegenerative diseases, nerves slowly stop working one by one (neurodegenerative disorder, n.d.). This can also correlate to RBD because there is a loss of atonia which allows your nerves to be active, making you move in your sleep (REM sleep behavior disorder, 2018). Treatment for this can be the treatment used for neurodegenerative disorders and as well as prevention for neurodegenerative diseases. As neurodegenerative diseases cannot be cured, people often use treatments that slow down the progression of the disease (Durães, Pinto, & Sousa, 2018). RBD, just like neurodegenerative diseases, can get worse over time (REM sleep behavior disorder, 2018), therefore the treatments used for neurodegenerative diseases may be used on RBD as well. RBD may be categorized as a movement disorder because patients often move in their sleep. The treatment used for neurodegenerative movement disorders are dopaminergic treatments (Mizuno, 2014). However, my research does not include finding an exact treatment currently as this conclusion may not be true. If an RBD patient wants to find ways to prevent neurodegenerative disorders, listed are certain ways to prevent neurodegenerative disorders. They may not be 100% effective, but they do help prevent to a certain extent. To prevent neurodegenerative diseases, physical activity is recommended (at least 15 minutes, 3 times per week); eating healthy and properly, dietary supplements like Alcar, vitamin B12, vitamin B9, Omega-3, and vitamin D is recommended; getting proper sleep that is not too little and not too much (at least 7 hours and at most 9 hours); and stimulating cognitive activity every day (like chess, playing an instrument, doing sudoku, etc.) will help prevent cognitive disorders (Zaremba, 2019).

3.2.2. If we do not receive desired outcome of Study 2 pt.1

This result would be the RBD scan having something different from the neurodegenerative and normal brain scans. This could mean that RBD has no connection to neurodegenerative disorder and that this experiment is helping us but isn't going in the same direction as the results.

3.2.3. If we do not receive desired outcome of Study 2 pt.2

This result is when the RBD scan has one thing in common with the neurodegenerative one but also one thing different from the neurodegenerative and two things different from the normal brain scan. This could mean that RBD does indeed have a connection to neurodegenerative disorders, but it also has another factor. Then this would open research up more, allowing more conclusions to be drawn. Maybe in the future, more research can be conducted to help us draw these conclusions.

4. Conclusions

In this paper, I have proposed several though experiments, and have also set up what each of the possible outcomes may mean. In the future, when we have stronger and better devices, hopefully even more research can be conducted. For example, in future research people can look for an exact treatment to RBD. This meaning that if we receive any of the desired outcomes, people will research more on which medicine is more effective for each scenario. In conclusion, RBD can possibly be a neurological or psychological disease and even though it may sound far-fetched, future research can help prove me wrong or right.

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