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The continuous illusion of motion after disembarking from a moving vehicle.

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Mal de Débarquement Syndrome (MdDS)

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WHAT IS MAL DE DEBARQUEMENT SYNDROME?

Mal de Debarquement Syndrome is a rare central vestibular disorder that typically arises following exposure to passive motion (i.e. boat, airplane, automobile, train, etc.). 'Mal de Debarquement' is French for 'sickness of dis-embarkment' [1]. This term originally referred to a short-lived sensation of movement felt as an aftereffect of travel on water by ship or boat [2]. For some individuals, these sensations do not improve, and after one month of experiencing these symptoms it is suggested that a patient has Mal de Debarquement Syndrome (MdDS).

The characteristic symptom of MdDS is a constant sensation of rocking, swaying and/or bobbing. There are a multitude of associated symptoms which are typical of most vestibular disorders, such as imbalance, unsteadiness, cognitive slowing, visual-motion sensitivity, brain fog and anxiety [3].

The most common onset for MdDS is exposure to passive motion [4]. Patients with this type of onset are referred to as Motion-Triggered (MT) MdDS patients. There is a subset within this clinical population that cannot attribute the onset of their symptoms to a motion event but rather to a non-motion event, or it may occur spontaneously. Non-motion events that have been associated with an onset of MdDS symptoms include surgery, childbirth, medication changes, traumatic experiences, and minor head injuries [5, 4]. These patients are referred to as non-motion triggered (NMT) or spontaneous-onset (SO) MdDS patients, or NMT/SO MdDS patients collectively [4, 6].

Though the NMT/SO MdDS subtype report identical symptoms to the MT MdDS subtype, recently the Barany Society has suggested that NMT/SO patients should perhaps be classified as a separate vestibular entity (Persistent Postural-Perceptual Dizziness), given the vastly

different onset causes and potential differences in the underlying mechanisms. Research into both subtypes is ongoing in the hope to identify similarities and differences between them and to clarify a potential classification.

Regardless of onset type, MdDS generally affects more women than men, with onset starting between 40 – 50 years of age [4]. Male subjects can also be affected, although they represent only 10 – 15% of the MdDS clinical population [7, 8, 5].

CURRENT ACCEPTED PHYSIOLOGIC CAUSES:

The research into MdDS is still in its infancy, though there are three main theories regarding the underlying cause of MdDS:

1. VOR Maladaptation (Dr. Mingjia Dai)
2. Functional Connectivity Issues (Dr. Yoon-Hee Cha)
3. Hormonal Dysfunction with a Noxious Oscillator (Dr. Viviana Mucci)

WHO IS MOSTLY AFFECTED?

As mentioned above, MdDS mostly affects women (roughly 85% of the clinical population), with onset around the age of perimenopausal transition [9, 10, 8, 5, 11]. The reason why this female predominance is present remains unclear, yet some hypotheses have been formulated (Mucci et al 2018 / 2020) [11, 5, 12].

WHAT CAUSES IT?

MdDS is normally caused by the exposure to an unfamiliar movement and then the removal of that movement (e.g. pitch, roll, sway). Sea travel is the most common precipitating event [13, 14, 2]. Today, it is known that MdDS is not an issue with the inner ear but rather of the brain and the way it integrates signals [2].

Peripheral vestibular tests in MdDS patients are usually unremarkable, though brain imaging studies have demonstrated changes in the brain metabolism and functional brain connections. Because of these changes, it has been proposed that the brain is able to adapt to an unfamiliar movement during the motion event but is unable to readapt once the movement has stopped [15].

Another hypothesis proposes that MdDS originates from a maladaptation of the Vestibular Ocular Reflex and velocity storage, caused by the exposure to passive motion. In simple terms, certain movements (such as those experienced on a ship or boat) expose an individual to novel movement patterns in all planes of motion [16]. During this time, the brain must send signals to the body so the muscles will be able to adapt to the novel movement patterns [17, 18]. This adaptation is often referred to as developing "sea legs." It has been proposed that after a while, the brain becomes accustomed to these novel movements; and in some cases, does not readapt to the old patterns once the movement has stopped [19]. Therefore, certain individuals are unable to redevelop their "land legs" [20]. Based on this theory, a treatment using optokinetic stimuli (essentially "moving light" therapy) has been developed. The hypothesis of the maladaptation of the Vestibular Ocular Reflex supports the usage of optokinetic exposure to reduce MdDS symptoms [21, 22]. As repetitive optokinetic exposure is able to adapt the velocity storage and modulate the Vestibular Ocular Reflex, this treatment has been proven to have the highest success rate in MdDS patients [21, 22].

In addition to this, another hypothesis was recently formulated from Mucci et al. Mucci and colleagues investigated the interaction of hormonal fluctuations in MdDS given the high female predominance as a potential underlying mechanism for patients who are unable to adapt to the novel movement patterns [5]. In patients of reproductive age, hormonal fluctuations associated with the menstrual cycle affect MdDS symptom severity and trigger sensitivity (higher symptoms during menses) [5, 12].

Recent studies have also investigated the role of reproductive hormones[5, 11] in triggering MdDS, highlighting that hormonal changes appear to be related to MdDS onset, with the majority of patients developing the condition during the age of menopausal transition [5]. In a small pilot study, women during pregnancy reported significant changes in their symptoms (reduction or complete resolution during the first two trimesters of pregnancy), similar to the alleviation of symptoms reported in those with migraine [5]. These studies have generated the hypothesis outlining that MdDS pathophysiology might be driven or partially influenced by specific hormonal fluctuations and phases [11, 12].

WHAT ARE THE SYMPTOMS?

The most common symptoms associated with MdDS are rocking, swaying, bobbing and disequilibrium [17, 23]. High visual sensitivity is also related to MdDS [4, 22]. As secondary symptoms, many MdDS patients develop anxiety and depression [4, 24]. Stress and/or fatigue cause the symptoms to become more noticeable in some individuals [4]. One particular aspect characterizing MdDS is that the symptoms often improve or even disappear when re-exposed to continuous movements such as those experienced while driving a vehicle [4, 25]. Overall, MdDS is considered a debilitating condition with a strong negative impact not only on a patient's physical health and psychology [4] but also on a patient's quality of life [26].

HOW IS IT DIAGNOSED?

Obtaining a diagnosis has proven challenging for MdDS patients around the world due to the lack of clear biomarkers (i.e. objective measurable data), and the lack of awareness of the condition [27]. Generally, neurologists and otolaryngologists (ENTs) are the most common healthcare professionals diagnosing the condition, though research is showing that primary care physicians / general practitioners are starting to diagnose patients too. MdDS patients are usually diagnosed through the currently available diagnostic criteria [7, 4] and patient history. However, in order to rule out other potential causes for the development of these symptoms, objective diagnostic procedures such as vestibular testing, radiological or laboratory diagnostic examinations and magnetic resonance imaging should be performed [27, 23]. If these test results are normal, then MdDS can be diagnosed through exclusion [28]. History and examinations from experienced physicians who are aware of MdDS symptoms is essential for making the right diagnosis. Personal or family history with migraine is a potential contributing factor and should be always enquired in patients presenting these symptoms [29].

HOW IS IT TREATED?

There are limited treatments that are available to MdDS patients [30]. Due to the poor understanding of MdDS pathophysiology, treatments are still experimental or address associated symptoms like anxiety and depression. The most successful treatment to date is the optokinetic rehabilitation protocol developed by Dr Mingjia Dai (vale) from Mount Sinai Hospital in NYC [21]. This treatment has a ~70% success rate in significantly reducing symptoms and occasionally helping patients move into remission. Though this treatment is available to patients, due to its specialized nature, it is only available at limited clinics around the world. (There are online versions of this treatment which should not be used unless under the guide of your healthcare professional. The treatment is powerful and has had detrimental effects on those who attempt to treat themselves without any guidance).

Benzodiazepine/antidepressant medication is typically prescribed to MdDS patients, and has been shown to be beneficial in reducing the symptoms of MdDS [30]. Stress-reducing treatments and symptom management strategies also seem to positively affect the patients [30]. Other treatments, such as neuromodulation seem promising, though are still in the research phase and therefore are not available to patients (unless they are participating in a clinical trial) [31, 32].

Addressing the migraine component in MdDS patients presenting with migraine comorbidity is also essential [29]. Physiotherapy and chiropractic treatments have not been shown to be beneficial to MdDS patients, unless it is addressing balance deficits present before developing MdDS [30].

If you have previously experienced MdDS and your symptoms have finally resolved, avoiding

the same precipitating event may be helpful in preventing a recurrence.

MdDS is a complex disorder that requires more research, yet in the current years the awareness related to MdDS has increased, and with this patient care and management can be improved.

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