SEASICKNESS

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Objectives

1. Understand the pathophysiolgy of seasickness
2. Appreciate the strategies to prevent seasickness
3. Be able to utilize alternative treatments for seasickness
4. Understand how to treat seasickness

Seasickness is a common and significant medical illness for mariners at sea, often responsible for maritime rescue operations. During stormy weather, mariners frequently consider seasickness a medical emergency and justification for medical evacuation. Each year, seaworthy yachts are abandoned because their exhausted and despondent crews have lost the collective will to persevere. “They are wet, seasick, scared, and want to go home,” observed a merchant marine captain (personal communication with author).

Seasickness is a self-limited condition; symptoms subside as one acclimates over 2 to 3 days. The balance center’s ability to adapt to new sea conditions is commonly called “getting your sea legs. ” Every one will develop seasickness with sufficient stimuli, even experienced offshore sailors; however, individual susceptibility is enormously variable. Pregnant women are highly susceptible, especially in the first trimester.

At best, seasickness *(mal de mer)* is moderately disabling. It can lead to rapid mental and physical deterioration marked by progressive dehydration, loss of manual dexterity, ataxia, loss of judgment, and loss of the will to survive. Fatalities from seasickness have occurred because of poor seamanship and complications arising during hazardous emergency evacuations.

Seasickness impairs cognitive function. Sailors often lose the ability to multi-task, making it difficult to analyze and integrate complex data, which leads to impaired judgment and faulty decisions. Cognitive failure is also expressed as loss of short-term memory. This impairment makes it difficult to engage in problem solving. Compounding this problem are the medications used to prevent or treat seasickness. Their side effects may include drowsiness, confusion, and loss of concentration.

The underlying mechanism of seasickness involves a conflict of sensory input processed by the brain to orient the body’s position. Someone positioned in the cabin of a heeling or rolling boat is inviting seasickness. Below decks, the eyes

oriented to the cabin sole (floor) and ceiling detects no tilt of the boat from vertical, while fluid in the inner ear's vestibular system (semicircular canals, and the otolith organs) constantly shifts. Your eyes tell the balance brain only about your motion relative to the cabin, but your inner ear responds the your motion relative to the boat and to the motion of the boat in the waves. Position sensors (proprioceptors) in the neck, muscles, and joints send additional signals, depending on how a person shifts and secures himself from falling. This mix of sensory data from the eyes, inner ear, and position sensors arrives in complex and conflicting combinations, creating a "sensory conflict" that activates the emetic center in the brainstem. According to Dr. Charles Omen, Director of the Man Vehicle Space Lab at MIT and an authority on motion sickness, the sensory conflict is predominantly a sensory cue "expectancy" conflict, not an intermodality conflict. It occurs when signals from the inner ear don't match learned and expected signals based on one's own commanded self-movement, or concurrent visual or proprioceptive cues.

When our brain generates motor signals for movement, it also generates the predicted sensory feedback that estimates the sensory consequence of the motor command. We then expect these predicted sensory signals, so that sensory signals generated from external stimuli in the environment can be distinguished from sensory signals resulting from our own actions. If there is a "sensory discrepancy" between these signals, the emetic link may be stimulated.

The actual sensory consequences of the motor command are then deployed to compare with the predicted sensory input to inform the CNS about how well the expected (desired) action matched the actual external action.

There are other interesting ramifications. It is theorized that it is not possible to tickle ourselves because when the predicted sensory feedback (of our actions to tickle ourselves) matches the actual sensory feedback, then the actual feedback will be attenuated, and we are not tickled. If the predicted sensory feedback does not match the actual sensory feedback brought on by external influences from the environment, the brain cannot predict the tickling motion on the body and a more intense tickling sensation is perceived. This is the reason why one cannot tickle oneself. The brain is constantly at work to distinguish between self-generated and externally generated sensory information.

In response to this “sensory conflict,” there is activation of a complex anatomic and neurochemical link between the vestibular nuclei in the brainstem, the cerebellum, and the autonomic and emetic centers (brain areas that control balance and those that trigger vomiting). Stimuli from the vestibular and visual systems can independently initiate symptoms. When these stimuli are presented in isolation in the laboratory, visual stimulation is more important than vestibular input in causing motion sickness. There is no increase in symptoms when combined stimulation is applied. Blind people can become seasick; the conflict arises when input from the vestibular system does not match the individual’s expectations derived from previous motion experience. The intensity of conflicting input can be amplified when compared to these expectations. Deaf subjects are susceptible to motion sickness. If the semicircular canals and otolith organs produce sensory cues that are incongruous, seasickness ensues. If the visual system indicates movement but the vestibular system does not (in-flight simulators and movie theaters), motion sickness may ensue.

Medication is very much more effective in preventing symptoms than in reversing them. Therefore, anti-seasickness medication should be administered in advance, before leaving port, or the night prior to departure (see table below) or at least, at the very first early signs of seasickness. One should begin any trip well hydrated and free of the after-effects of alcohol, which impairs vestibular function by sensitizing the vestibular apparatus to motion. One is advised to eat lightly. Anecdotal reports favor eating carbohydrates rather than protein, but no conclusive study favors any particular food or diet influencing susceptibility to seasickness. One should try to snack on bland foods throughout the day, even if anorectic, to maintain energy levels until meals are regularly tolerated. Cheese and crackers, energy bars, fruit, trail mix, dry granola, and popcorn work best. Drinking small amounts of fluid frequently is recommended to avoid dehydration. Many sailors believe drinks high in vitamin C prevent seasickness, however, there are no data to support this notion. Gatorade is a good choice because of the mixture of sugar and electrolytes.

Ginger is often recommended as an antiemetic and may be clinically useful in individual cases. However, there are very few controlled trials. In one trial, ginger was tested in a double blind, randomized, placebo-controlled study of 80 naval cadets in rough seas. Seasick cadets were given a gram of ginger or placebo hourly for 4 hours. Ginger significantly reduced vomiting and cold sweats, and minimally decreased nausea and dizziness. Ginger is readily available in 500mg capsules in health food stores and sold in marine stores as Sailor’s Secret®. The suggested dose is 1000mg every 6 hours, starting one-half hour prior to the trip; it is less effective when given to someone who is already nauseated. The capsules

can be supplemented with foods containing lower concentrations of ginger, such as gingersnap cookies, ginger ale or tea, and candied ginger. Too much ginger may cause heartburn; people with gallstones should not take it, because it can provoke an attack of biliary colic by stimulating the flow of bile.

Both field and laboratory experiments have documented the efficacy of acupressure in preventing seasickness. However, some experts on space and motion sickness still consider acupressure no better than placebo. One sea trial showed that acustimulation suppressed the symptoms of motion sickness. Pressure should be applied on the Nei-kuan P6 point of the forearm over the median nerve. This is found two to three fingerbreadths proximal to the wrist joint between the two prominent finger flexor tendons. There are commercially available elastic wrist straps with plastic studs that create pressure over the P6 point. A wristwatch-like device is sold to deliver transcutaneous electrical stimulation to the median nerve; these have not been proven useful for seasickness, but have many advocates. Controlled trials of these products are lacking but certainly the inexpensive wristbands with pressure point studs are worth a try.

Recommendations for preventing seasickness are directed toward reducing sensory conflict by limiting the time below decks while underway. Prepare meals ahead of time, and have personal gear readily accessible. After departure, stay on deck and amidships (center) or aft (toward the stern), where pitching and rolling are less severe. Obtain a broad view of the horizon using direct and peripheral vision. This provides a stable and level point of reference. Avoid close visual tasks such as prolonged reading, writing, and navigation. Avoid areas with fumes (especially diesel) and odors that can stimulate nausea; continue medication for preventing seasickness at the suggested intervals; try tapering the dose after the first or second day.

The early signs and symptoms of seasickness are yawning, drowsiness, and lethargy, frequently associated with sighing, dry mouth or salivating, headache, and dizziness. Mild seasickness reduces alertness and initiative. With sustained exposure to the stimulus, gastric emptying is inhibited. Pallor, cold sweats, belching, waves of nausea, dry heaves, and vomiting ensue. Some persons don’t have gastrointestinal complaints but experience headache, apathy and depression. The window of opportunity for early intervention is often missed because early signs are either not recognized or the victim is in denial. The side effects of some anti-seasickness medications can also mimic seasickness, and confuse the picture.

At the first sign of seasickness, one immediate remedy for many is to take the helm and steer. The active mental and physical activity to steer the ship, together with a broad view of the horizon in your peripheral vision, presumably

creates neural feedback loops that help to reorient the body's equilibrium. One should stand and feel the waves, and steer the boat by reference to clouds, the horizon, distant marks and oncoming waves, posturing to anticipate the boat's motion by "riding" the waves. Wave riding synchronizes sensory input and expectations of motion. As best as possible, one should keep the head, shoulders and upper body balanced over the hips, to stay in balance and gain postural control gracefully, as though the body was truly "gimbaled" on the deck. Sitting in the cockpit, one can still ride the waves and watch the horizon. Chuck Omen, an authority on motion sickness developed the concept of wave riding. He advises: "Don't sit or lie inert in the cockpit, passively letting the motion toss you around. Postural anticipation of the boat's motion is the natural cure for seasickness. " Tell the skipper or others on watch how you're feeling and consider a small change in course to alter the boat's motion. Debilitated seasick persons can easily fall or be washed overboard. They should always wear a safety harness on deck and be closely monitored. In storm conditions, the safest place to be secured is below in a bunk.

If symptoms progress, one may lie down in a secure, well-ventilated bunk, face up with eyes closed and head still in an attempt to sleep. Wedge yourself in with blankets, cushions, sail bags, or duffels. "Your balance brain can go off watch only if you don't have to hang on to stay in your berth," says Chuck Omen- and then sleep will allow you to recover.

Keep all medications dry and in a handy location. Parenteral anti-nausea medications include the phenothiazine derivative Promethazine hydrochloride (Phenergan®). This drug has powerful antidopaminergic, anticholinergic, and antihistamine properties. The latter effects predominate (see other side effects below). Anticholinergic side effects include: constipation, xerostomia, blurred vision, and urinary retention. Rare but serious_adverse effects of Promethazine include extrapyramidal reactions. Promethazine is useful for prophylactic and active treatment of seasickness and can be administered as a suppository, by deep IM injection, and orally as a tablet or syrup. NASA astronauts use a combination of intramuscular or oral Promethazine with oral dexedrine (to counter the drowsiness induced by Promethazine. Some sailors prefer Prochlorperazine suppositories for nausea, and many have used Ondansetron oral disintegrating tablets (Zofran®) to treat nausea and vomiting. Zofran® does not, however, prevent seasickness. Transdermal scopolamine hydrobromide (Transderm Scōp® patch) is the most popular anticholinergic agent used for prevention of motion sickness. Scopolamine prevents motion-induced nausea by inhibiting vestibular input to the central nervous system, resulting in inhibition of the vomiting reflex. It may also act directly on the vomiting center. The drug is delivered via an

adhesive patch placed behind the ear four or more hours before departure; the patch will last for up to three days, often with minimal side effects. The most common adverse effects are dry mouth (66%) and drowsiness (17%). Other undesirable side effects include blurred vision (which may persist for weeks), dry mucous membranes, short-term memory loss, and problems denoted by the well-known mnemonic "hot as hell, dry as a bone, blind as a bat, mad as a hatter. " To reduce the dose of scopolamine, allow only half of the intact patch to contact the skin by placing the other half onto a Band-Aid® or tape attached to the area. Do not disrupt the integrity of the disc by cutting it. Follow the directions carefully, wash hands thoroughly after application because temporary blurring of vision and dilation of the pupils may occur if the drug is on your fingers and comes in contact with the eyes. Apply only one disc at a time. Scopolamine is contraindicated for children, persons with narrow-angle glaucoma (remove the patch immediately if eye pain occurs suddenly), and men with prostatic hypertrophy. Long-term use may produce withdrawal symptoms such as nausea, dizziness, headache, and equilibrium disturbances. Scopolamine in pill form (Scopace®) was an alternative to the patch. It is no longer available, except at a few compounding pharmacies.

The antihistamines Meclizine (Bonine®) and Dimenhydrinate (Dramamine®) are available "over-the-counter" (OTC) without prescription. They are effective for many sailors, as are the other prescription medications listed in the Table below. The popular antihistamine Cinnarizine (Stugeron®), is not sold in the United States, but is available OTC in Europe, Bermuda, Mexico, and Canada. It can be obtained legally from online Canadian pharmacies. Many sailors favor it because it is less sedating than all the other antihistamines and has fewer reported side effects described below.

Side effects of over-the-counter antihistamines include drowsiness, dry mouth, blurred vision, irritability, urinary retention, dizziness, and headache. Meclizine (Bonine®) is thought to cause less drowsiness and confusion. Antihistamines cause thickened bronchial secretions, and should be used with caution in people with asthma and COPD. An effective nonprescription drug to counteract drowsiness is the decongestant pseudoephedrine, which is available in 30 to 100 mg; caffeine 200 mg is also useful and may potentiate the beneficial effects of Promethazine. The newer generation of non-sedating long acting antihistamines (e.g. Zyrtec®) are ineffective in preventing seasickness.

All therapies are subject to placebo effect, and there are no well-controlled trials comparing and evaluating different treatments. Many products cite only testimonials. The protection conferred by drugs is a matter of degree; there is no magic bullet to prevent seasickness in everyone. It is not uncommon for one drug in a category (e. g. antihistamine) to be effective and a related drug to provide no

benefit; the same is true for side effects. Evaluate medication side effects before boating. If all else fails, follow Samuel Johnson's 18th century advice: "To cure seasickness, find a good big oak tree and wrap your arms around it. "

MEDICATONS FOR SEASICKNESS	Dose	Interval
Diphenhydramine, (Benadryl)(OTC)	25-50 mg tablet	6-8 hr
Dimenhydrinate, (Dramamine) (OTC)	50 mg-100mg tab (max 400mg/day)	4-6hr
Meclizine (OTC)	12.5/25-mg tablet (max 100mg/day)	6-8hr
Bonine (Meclizine) (OTC)	25-mg chewable tablet	6-8 hr
Cinnarizine, (Stugeron)	15-mg tablet (max 100mg/day)	6-12hr
Scopolamine, (Transderm Scōp®)	1.5-mg skin patch	72 hr
Promethazine, (Phenergan)	12.5/25/50-mg tablet, suppository, IM	Variable intervals depending on dose/preparation