A patient arrives alert and conscious to the Trauma Center at the Dartmouth Hitchcock Medical Center (DHMC). As an adult Hispanic woman with no preexisting psychological condition, she is unremarkable - save for the fact that she has survived an acute life-threatening event. She is interviewed upon arrival and administered a series of tests to quantitatively assess her injuries. This process is the beginning of a screening phase: it is ascertained that the patient can recall her trauma; that she can call to mind having reacted to the experience with fear, helplessness, or horror; and that she presents no signs of traumatic brain injury (Mellman et al, 2001). Fortunately, her physical wounds heal with time but, a month later, she is still suffering from psychological damage.

Post Traumatic Stress Disorder (PTSD) has long been recognized as a problem for battle-scarred soldiers or survivors of major natural disasters (Weisberg, 2000). This, however, masks the fact that the disorder is far more common, with approximately one-third of the individuals hospitalized for traumatic injuries expected to develop symptoms of PTSD (Mellman, 2001). Severe traumatic injury is an important antecedent to PTSD and encompasses not only events like military combat, but also sexual assault, motor vehicle crashes, and industrial accidents.

I was privileged to contribute to the second phase of a study under the guidance of Thomas Mellman M.D., at the Dartmouth-Hitchcock Medical Center that aims to identify early predictors of PTSD related to severe traumatic injury. The objective of Dr. Mellman’s work is to better understand the mechanisms of early pathogenesis with the ultimate goal being the development of preventive interventions (Mellman et al, 2001). Part of the motivation for such a study is the fact that, once established, PTSD is often chronic, demonstrating a low probability of remission if untreated. Furthermore, the syndrome is linked with an increased likelihood of co-occurring psychiatric disorders including depression, phobias, troubled interpersonal relationships, and violent behavior, as well as physical ailments including headaches, gastrointestinal complaints, immune system problems, dizziness, and chest pain (National Center for PTSD, 2002). Such symptoms, in turn, are a significant cause of the disability that can plague a victim for months or years following injury (Mellman, 2001). An additional problem of PTSD is that perpetuation of intrusive memories about trauma preclude the grieving and recovery process. People who suffer

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from PTSD often relive the experience through nightmares and flashbacks, have difficulty sleeping, and feel detached or estranged. These symptoms can be severe and long lasting enough to significantly impair the person’s daily life (National Center for PTSD, 2002).

Since PTSD is marked by biological changes as well as psychological symptoms, polysomnographic (PSG) measures were taken. A polysomnograph is essentially a mechanical recording of a person’s sleep, using many criteria, such as the amount of oxygen in bloodstream, pulse, brain waves and eye movement, amongst others. Measures are recorded on paper, not unlike a seismograph. I assisted in comparison of these PSG measures between groups of individuals who were or were not manifesting PTSD symptoms in the aftermath of serious trauma, in addition to a group of non-injured controls. Special attention was paid to the characteristics of rapid eye movement (REM) sleep (Mellman et al, 2001).

I learned that there are a number of reasons to suspect that sleep could have an influence on regulating trauma memory during the acute period following trauma exposure. Sleep is a restorative state of reduced stimulation, and its disruption can induce tension, anxiety, and irritability, which are also characteristics of PTSD. Specifically, REM sleep, the sleep stage when most dreaming occurs, is postulated to have a role in “integrating,” or processing, traumatic memory by the use of distinct patterns of cortical activation (Mellman et al, 2001). Previous assessment of dreams in traumatically injured patients relates dream characteristics with reconciliation of traumatic memory, meaning that dreams following trauma can aid emotional adaptation while nightmares that replicate or “replay” the trauma are diagnostic of PTSD pathogenesis. This, in turn, may potentially be implicated by abnormal REM sleep patterns (Mellman et al, 2001).

We began with the assessment of PTSD symptoms using the Clinician Administered PTSD Severity Scale (CAPS) and a structured clinical interview for orientation and recall (Personal Conversation). In this “screening,” the patient deconstructs the accident into several phases. “Pre-accident recognition” addresses whether the patient had any forewarning of the trauma. Recall can exist continuously or in “flashbacks,” and any gaps in memory (“amnesiatic periods”), are elucidated at this time. Phase 2 discusses the accident itself. The “post-accident” phases concern time spent waiting for rescue, followed by extrication, transport, resuscitation, and hospital stay as needed (Personal Conversation). Overnight PSGs were conducted within one month after the trauma took place. Timing was important. While measures of initial trauma reactions are significant, processes that occur during the first 1-2 months following trauma are also key determinants of the development of PTSD (Mellman et al, 2001).

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In fact, duration of symptoms for at least one month is a diagnostic criterion for PTSD (Mellman et al, 2001).

Interestingly, there are still other risk factors for the development of PTSD following injury, relating to the type of trauma sustained, the characteristics of the population studied, and the timing of the assessment (Personal Conversation). This reality naturally had some bearing on our study. Specifically, the type of trauma sustained here was sudden, intense, impersonal, and life threatening, accompanied by physical injury with a relatively short period of exposure. Also, the majority of subjects were Hispanic, which poses the interesting question of PTSD development and immigrant status - a population group demonstrated in previous studies to have higher levels of psychological stress (Mellman et al, 2001). While post-traumatic stress is an enduring consequence of trauma and PTSD can be found today across genders, cultures, and socio-economic groups, it is plausible that conducting part of the study in a predominantly Hispanic community in Miami, Florida, would have conferred some additional vulnerability to the development of PTSD following acute trauma (Mellman et al, 2001).

From the PSGs, “epochs” (30 second intervals) of sleep were scored, and from these, I was able to calculate values for sleep initiation and maintenance. “Sleep latency” was defined as the first epoch of at least 10 minutes of uninterrupted sleep. The amount of wake activity after sleep onset prior to final awakening is called “wake during sleep” (WDS) and served as the index of sleep maintenance. Finally, REM density was calculated by dividing the number of REMs by minutes of REM sleep (Mellman et al, 2001). With each calculation and every new “subject,” the continual question on our minds was how the activation of a trauma memory, in conjunction with disruption of REM sleep by awakening, contributes to PTSD and how this can ultimately be targeted for intervention.

How was this “activation” achieved? A memory testing procedure was added for injured and healthy subjects receiving PSGs with the aim of determining if implicit recall of neutral stimuli is impaired in subjects developing PTSD and if recall of trauma-related stimuli is enhanced. Part of my task was to gather visual and verbal stimuli that have certain specific characteristics in common but that could also be juxtaposed with each other and classified as either “trauma-relevant” or “trauma-neutral.” It was hypothesized that patients’ correct identification of the stimuli would vary due to priming effects. We searched for similar variations among patients in order to possibly relate REM sleep and dream patterns. Stimuli consist of 40 words (in English or Spanish depending on the patient’s primary language), plus pictures that are programmed to slowly appear out of a background and onto a computer screen. Participants signal as soon as they recognize the stimulus. This generates a reaction time (“recognition latency”), which correlates to a “priming effect” (a form of “implicit learning”). Specifically, we expected reductions in reaction time on previously exposed versus unexposed stimuli (Mellman, 2001). Two movies were developed, Tests 1 and 2, one containing 18 word and picture stimuli and the other containing these 18 stimuli plus interspersed “novel” stimuli.
We found that recognition latencies were similar for pictures and words, but “priming” was supported by significantly shorter average recognition latency for the “old” versus the “novel” stimuli, suggesting the tendency for people to mistake a new word or image for something that is familiar to them. By the numbers, on average 70 percent of “old” stimuli were correctly identified by subjects and as much as over one-quarter of “novel” stimuli were falsely identified as “old” (Mellman et al, 2001).

A study done at Harvard by Stickgold and colleagues suggests that conditions of REM sleep appear to favor co-activation of memory networks distinct from those of the waking state (Personal Conversation). Subjects were administered a semantic priming test for weakly associated word pairs just after being awakened from REM sleep. Priming was weak. This contrasts with maximal priming with strongly associated word pairs when subjects were fully awake. Other studies support that REM sleep activity has an effect on memory that endures after awakening, and it is this attribute of REM sleep that acts in the adaptive “integrative” functions postulated (Mellman, 2001). Subjects developing PTSD more frequently entered the wake state from REM sleep, leading to the conclusion that activation of unaltered trauma memories and disruption of REM sleep may contribute to PTSD development (Personal Conversation). This knowledge proves vital because integration of trauma memory is thought to be an important component of successful emotional processing during PTSD therapy.

As expected, there was indeed evidence for disrupted sleep in the injured patients. Ten of twenty-one injured subjects were grouped as being positive for PTSD and comparison of sleep measures between these PTSD-positive subjects and PTSD-negative injured subjects and the non-injured controls reveal a more significant amount of wake during sleep (WDS) and activity in the PTSD-negative group compared to the controls. Furthermore, the study turned up some intriguing surprises. The PTSD-positive group exhibited a greater number of REM periods than the PTSD-negative group and shorter average duration of continuous REM sleep compared to both other groups. In other words, PSG analysis proved that the group that developed PTSD symptoms was distinguished by findings indicating a more fragmented pattern of REM sleep, specifically, shorter average duration of REM sleep compared to both other groups and a greater number of REM periods than the PTSD-negative injured group. Interestingly, development of PTSD was significantly positively correlated with the number of REM periods and negatively correlated with the average duration of continuous REM sleep (Mellman et al, 2001).

Overall, then, although alterations of REM sleep were not proven to be causal occurrences in the development of PTSD, the data suggest that the adaptive functions of REM sleep following trauma depend not on the mere amount of REM sleep but on its duration without disruption (Mellman et al, 2001). Hopefully, such findings regarding the symptoms associated with PTSD will continue to advance the clinical care and well-being for the nearly 10 million American children and adults who are affected by PTSD (National Center for PTSD, 2002). Perhaps this may lead to the development of therapeutic
drugs that better target the biological changes marked by PTSD. With such a high prevalence of assault, rape, and disaster in today’s society, it becomes exceedingly important to acknowledge PTSD as a serious threat to the physiological and psychological wellness of trauma victims. Such a discussion seems especially appropriate in light of the many lives recently touched by the tragedy of September 11, 2001. We must remember that for most of the survivors of 9/11, the trauma continues to this day.

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