Posttraumatic Stress Disorder: Neurobiology, Psychology, and Public Health

March 01, 2008 | Schizophrenia [1], Comorbidity In Psychiatry [2], Mania [3], PTSD [4], Addiction [5], Alcohol Abuse [6], Amyotrophic Lateral Sclerosis [7]

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In recent years, we have learned a great deal about posttraumatic stress disorder (PTSD) and its public health implications. From 9/11 to Katrina and the present Iraq war, PTSD has been in the forefront of health concerns and public policy. Recent advances as well as emerging needs are leading us to new and exciting opportunities to provide better care and gain a better understanding of the complex nature of human responses to traumatic events. As we look to the future, we can be both reassured and concerned that it will, on one hand, be similar to the present and, on the other, provide new opportunities and challenges for care of those exposed to traumatic events—natural and human-made, large- and small-scale.

PTSD is a disorder of forgetting perhaps even more than of remembering. It is the inability to forget the trauma that leads to the pathology and suffering in PTSD. Forgetting is a critical component of recovery. Of course, if we could not forget, our brains would rapidly be cluttered with information and observations and perhaps more limited in cognitive control functions for other activities.

PTSD is not uncommon following many traumatic events from terrorism to motor vehicle accidents, or industrial explosions (Figure 1). In its acute form, PTSD may be like the common cold, experienced at some time in one's life by nearly all. Some colds progress to pneumonia and may create substantial illness and impairment of function. Similarly, PTSD, when it becomes chronic, may cause major distress and requires psycho-therapeutic and/or pharmacological intervention.

To understand the breadth of the emerging treatments, interventions, and comprehension of PTSD and other trauma-related responses, we must think across neurobiology, psychology, and community and from individuals to populations. In all areas, breakthroughs and opportunities as well as challenges are evident. Neurobiology

The power of translating across human tissues, animal models, and biomarker studies is remarkable and offers opportunities to identify treatment targets not previously recognized. In the past year we have seen the first studies of postmortem PTSD human brain tissue. Exciting and groundbreaking studies have shown the possibility of identifying critical gene activity in PTSD related to various brain regions.

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In the past year we have seen the first studies of postmortem PTSD human brain tissue. Exciting and groundbreaking studies have shown the possibility of identifying critical gene activity in PTSD related to various brain regions. In the prefrontal cortex and the amygdala, for instance, studies have suggested that there are unique genes in patients with PTSD, some of which (eg, the p11 gene) have also been found in animal models of PTSD and initial biomarker studies. Recent studies of hurricane victims have shown that PTSD is 20 times more likely to develop in those with the short/short genotype of the serotonin transporter gene (5-HTTLPR) and poorer social supports. The science of PTSD now requires a well-developed brain bank like those that exist for other psychiatric and neurological disorders (eg, schizophrenia, depression/mania, amyotrophic lateral sclerosis, Alzheimer disease).

The development of animal models is also critical for the study of therapeutic and prophylactic treatments of stress-associated psychiatric disorders, such as PTSD. Our increased ability to identify endophenotypes—specific genetically linked behavioral characteristics/phenotypes—that relate to PTSD will greatly enhance our neurobiological understanding.

Historically, adequate animal models have been central to developing effective therapeutic treatments. Our present animal models of PTSD include models of predator stress, social defeat, shock, restraint and shock, and serial prolonged stress. None is complete, but each provides a model of different symptoms of the trauma response. Knock-out and knock-in strains offer additional sources of study. Animal models have rarely addressed the observation that even in animal species (as in humans) PTSD-like symptoms being studied in the particular model do not develop in all individual animals; this is an important area for additional future study to identify resilience and...
As noted above, PTSD is a disorder of forgetting. It is the inability to forget that leads to the pathology and suffering in PTSD. In clinical practice, forgetting is often overlooked as an important part of recovery, not only pathology. Forgetting is critical to our ability to maintain attention and conserve cognitive resources. Extinction of fear is one paradigm for examining forgetting.\textsuperscript{10-12}

Extinction—which may also be conceived of as new learning—is a potentially important mechanism for PTSD formation and also for its treatment.\textsuperscript{13} Guthrie and Bryant\textsuperscript{14} have shown that PTSD is more likely to develop following a traumatic event in firefighters who had shown impaired extinction before exposure. Similarly, those with PTSD show impaired ability to extinguish conditioned responses.\textsuperscript{15-17} The ventral medial prefrontal cortex appears to be central to extinction of conditioned fear. Understanding of the story of extinction, forgetting, and the prefrontal cortex holds opportunities for treatments yet to come. Public health

Events from the war in Iraq to bombings in London to Hurricane Katrina have reminded us of the important public health issues raised by PTSD. The public health response to large-scale emergencies and catastrophes requires consideration of the disorders (eg, PTSD, depression), distress (eg, sleep disturbance, fear, changes in economic behaviors such as purchasing houses), and health-risk behaviors (eg, increased smoking, evacuation behaviors) of those who have been exposed (Figure 2).\textsuperscript{18,19} Because the National Comorbidity Replication study had surveyed the mental health of those in the Katrina disaster region before the hurricane struck, we know that the rates of mental disorder had doubled 6 months after Katrina, from about 15% to 30%.\textsuperscript{20,21} The mental health costs of this, the largest natural disaster to hit the United States, continue to be seen today. Such disasters, as well as those caused by terrorism and war, remind us that recovery of populations is a long and arduous process.

In another area of public health, far too common internationally, more than 29 armed conflicts are occurring now around the globe involving 25 countries.\textsuperscript{22} For those in the United Kingdom and United States, Iraq and Afghanistan are the present teachers of lessons long known and too often forgotten. Epidemiological surveys conducted during the current conflicts in Iraq and Afghanistan suggest that as many as 13% to 17% of service members screened positive for PTSD.\textsuperscript{23} The Mental Health Advisory Team (MHAT), established by the office of the US Army Surgeon General, assessed the mental health of deployed US soldiers in the fall of 2006. This team noted increases in behavioral health consequences for service members involved in multiple deployments. Soldiers who had been deployed to Iraq more than once were more likely to screen positive for acute stress (PTSD), anxiety, depression, or any mental disorder than those who had been deployed only once. Soldiers deployed multiple times were 1.6 times more likely to screen positive for PTSD than those deployed once, and 1.2 and 1.7 times more likely to screen positive for anxiety and depression, respectively. Soldiers deployed for more than 6 months were 1.5 to 1.6 times more likely to screen positive for acute stress than those deployed for less than 6 months.\textsuperscript{24}

War, terrorism, and natural disasters create large populations in distress. Not all distress amounts to mental disorder, but fear, worry, insomnia, and changes in health-risk behaviors all contribute to the health burden of mass violence and are targets for early public health intervention. Substantial evidence supports essential principles of immediate and midterm mass trauma interventions that are now described as psychological first aid.\textsuperscript{25} But translating these principles into widely accepted (ie, destigmatized), rapidly disseminated, culturally informed intervention programs and policy remains a present and future challenge.\textsuperscript{26}

In order to alter or affect behavioral change in individuals exposed to disaster, it is important to consider the social context or environment. Evidence-based and evidence-informed clinical trials have shown that efforts to modify individual behavioral risk factors such as drug, alcohol, and tobacco use, diet, and physical activity, the most successful approaches have incorporated elements of social organizational interventions and changes.\textsuperscript{27} For example, people who are socially isolated are more likely to engage in risky behaviors and are less likely to engage in behaviors that promote health.\textsuperscript{28,29} Successful behavioral and health interventions incorporate the social context of the individuals' communities, work sites, and families.\textsuperscript{30,31} New models of monitoring shifting community health care needs in real time (ie, mental health surveillance) as well as innovative models for delivering care are required.\textsuperscript{32} The mental health community’s response to disaster requires the collaborative efforts of the public health system, medical care system, and emergency response systems.

The role of primary care providers after community exposure to disasters and terrorism is substantial. Collaboration of mental health care providers with primary care providers is an important and underdeveloped model for providing services to a large number of patients. Patients
with chronic somatic symptoms, often seen after trauma exposure, respond best to a single primary care provider with regular visits in which conservative medical management and education play a primary role. The availability of mental health consultation and psychiatric health care extenders facilitates the recovery of those exposed to traumatic events. Often, health care planners and providers underestimate the duration of the impact of a terrorist event or disaster on a community, focusing primarily on the acute impact rather than on the recovery stage. Such overemphasis of the impact stage neglects the important elements of recovery that include the stress of relocation and new life events involving altered economics, social settings, stigma, and job loss that occur in communities hit by disaster. These postdisaster events and secondary adversities have substantial impact on the psychological distress and health of individuals and communities and are risk factors for PTSD. In addition, the recovery of those with PTSD, whether from war or disaster, requires making resources available for care and addressing the barriers to care and adherence with health care recommendations. Only 32% of those in whom a mental health disorder developed following Katrina had accessed care 8 months later. Looking at the future

So, what is on the horizon? First, PTSD will be the first mental disorder to be preventable. It already is. Studies by Bryant have shown that cognitive-behavioral therapy given at about 3 weeks to those with acute stress disorder can lower the rates of PTSD. Similarly, we know that using seat belts—a protective behavior—prevents injury and injury is one of the strongest predictors of PTSD resulting from motor vehicle accidents. Current research also offers promise of early pharmacological intervention to prevent PTSD, perhaps targeted to those with risk genes. In addition, studies of PTSD biomarkers suggest that we will have both biochemical (eg, blood) and brain imaging biomarkers to predict the risk of PTSD as well as for stages of the disease process.

Second, present studies on the importance of integrating PTSD detection and treatment into primary care (and as part of screening for those who are injured) suggest that collaboration with our primary care colleagues can provide the best public health approach to PTSD, particularly in disaster populations. Easily administered screenings and algorithms for primary care treatment and referral for specialty care are needed.

Third, we can hope that the current experience with PTSD may lead to the development of postdisaster, real-time mental health and risk-behavior surveillance—just as is done for other injuries and disorders that may impair communities, such as surveillance for infectious diseases. Such changes can decrease the stigma of mental illness as the public better understands psychiatric illness as being similar to other disorders. Finally, as we better recognize PTSD as a disorder of forgetting, we may well learn a great deal about when forgetting is important to assist health and when it may impair health, a fundamental issue for all psychotherapies.

The Table lists some of the aspects of potential treatment and care for PTSD in the future.

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