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Brain Science in the 21st Century: Clinical Controversies and Ethical and Legal Implications

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Study of the brain, including cognition, intelligence, and reason, dates back to antiquity. The earliest use of the word “brain” was in the Edwin Smith Papyrus, dated 1700 B.C.E., which contains a series of 48 trauma cases, of which the first 10 are wounds of the head. These cases provide the first known descriptions of the meninges, the surface of the brain, and the cerebrospinal fluid.¹ At that time, however, Egyptians believed that intelligence resides in the heart, not in the brain. More than a millennium later, Hippocrates and Plato located intelligence in the brain, but Aristotle's belief that the heart rather than the brain is the seat of intelligence was generally accepted until Galen in the second century observed the loss of mental function following brain injuries in gladiators and located intelligence in the brain, where it has remained since.²

Medical knowledge and practice remained virtually stagnant, based on Galen's views, until modern medical science was initiated by William Harvey in the 17th century. Like the rest of science and medicine, neuro-science developed slowly from Galen's time through the middle ages, until the invention of the microscope in the 17th century led to better understanding of the brain. The development of neuroscience accelerated even more rapidly with the introduction of electricity into studies of the nervous system in the 18th and 19th centuries. These advances were led by such giants of science as Luigi Galvani, Hermann von Helmholtz, Camillo Golgi, Santiago Ramón y Cajal, Paul Broca, and John Hughlings Jackson.

Rapid development of neuroscience in the 20th century led the U.S. Congress to designate the decade beginning on January 1, 1990, “The Decade of the Brain.”³ Major recent advances have been related to developments in molecular biology, electrophysiology, and computational neuroscience. Although neuroscience traditionally has been a branch of

About This Symposium

This symposium issue consists of papers presented at the 19th Annual Thomas A. Pitts Memorial Lectureship, October 26-27, 2012. The endowed lectureship, held annually since 1993, is funded by the Medical University of South Carolina Foundation through a bequest from Dr. Pitts, who served on MUSC's Board of Trustees for 36 years, including 25 years as its chair. The conference was presented by the Medical University of South Carolina, the Institute of Human Values in Health Care, and the South Carolina Clinical and Translational Research Institute.

biology, it has become broadly interdisciplinary, bringing together medicine, law, psychiatry, psychology, computational science, mathematics, philosophy, physics, genetics, engineering, and evolutionary studies, among others. This interdisciplinary activity has spawned several new disciplines, such as neuroethics, neurolaw, neurotechnology, and neuroeducation, as well as several specialty societies to serve these new disciplines.

Neuroethics addresses a broad range of ethical issues, some of which are shared with bioethics in general, but some are specific to the brain, for example, problems related to brain interventions, imaging, cognitive and behavioral enhancement, disorders of consciousness such as coma, minimal consciousness, and vegetative states. Similarly, the discipline of neurolaw addresses a broad range of ethical issues, for example, crime prediction, insanity defense, lie detection, and brain death.

The current symposium, *Brain Science in the 21st Century: Clinical Controversies and Ethical Implications*, addresses several of the current controversial issues in neuroscience, including head trauma, stroke, posttraumatic stress disorders, and the treatment of brain cancer.

Despite the neuroscience advances of recent decades, the still-dark regions of the unknown far exceeds those of the known. As answers have been sought to questions of structure, function, and their ethical, legal, and social implications, many controversies have arisen, some have been resolved, and others are still being debated.

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The effects of concussive injury to the brain have received a great deal of attention in recent years because of recognition that such injuries are associated with long-term morbidities. Jonathan Edwards and Jeffrey Bodle describe the physics and physiology of concussion as it relates to sports injuries, particularly the effects of repetitive concussions and their relation to chronic traumatic encephalopathy.⁴ They explore some of the ethical difficulties that arise from concussive injuries, such as underreporting of symptoms by athletes who are anxious to continue competing, the difficulties of treating injuries in the absence of accurate information, and the implications of second impact syndrome. The management of concussion often involves a delicate balance between safely returning an athlete to competition while avoiding unnecessary restraint from participation. Many different approaches have been used to prevent concussion, ranging from equipment technology, such as helmet design, to educational programs for players, coaches, and administrators, which are sometimes mandated by law.

Accompanying this paper is a personal commentary by Joe DeLamielleure, a former National Football League offensive lineman who played in six Pro Bowl Games and is a member of the Pro Football Hall of Fame.⁵ He describes his personal experiences as a victim of head trauma acquired while playing in the NFL and explains the fate of several of his fellow players who suffered from chronic traumatic encephalopathy. He lauds the NFL

for its role in helping to reduce head injuries and also suggests a few things the league could do better. He believes an important source of head injury is the highly protective face mask, which has encouraged players to hit with their heads more often than they did with older helmet designs and advocates a return to less-protective face masks.

Sickle cell anemia is mostly found in African-Americans. Because of a hemoglobin abnormality, blockage of small blood vessels is a frequent problem, and the most devastating consequence of sickling is stroke due to occlusion of the arterial supply to the brain. Preventing stroke in sickle cell disease has been a focus of much research for decades. Robert Adams, a national leader in stroke research, describes the abnormalities that result from sickle cell disease, focusing on the causes and consequences of stroke.⁶ He describes several ethical issues as well. Blood transfusion to replace abnormal red blood cells can be an effective method of treatment, but involves a balance between its preventive effectiveness and the risks of blood transfusions, such as transmitted infection and iron overload. Parental objection to blood transfusion sometimes complicates efforts to prevent and treat this disease.

One of the symptoms arising from the vascular occlusion of sickle cell disease is chronic pain, which has only recently been recognized to be far more common than was previously appreciated. Wally Smith has been a leading figure in research on health disparities and has had a special interest in sickle cell disease.⁷ He describes the pathophysiology of the disease, including the various sources of pain, such as those associated with inflammation or with neuropathy. An important legal and ethical issue involves the use of opioid analgesics to treat chronic pain; specifically, the frequency and dosage of opioids in this setting has long been controversial because of problems related to opioid abuse and diversion, as well as the dangerous side effects of the drugs. Some of the fear of addiction and other abuses is misplaced, and many physicians are uncomfortable with the higher doses of opioids that are often required to treat chronic pain. He describes several ethical principles guiding the prescription of opioids.

Three of the papers in this collection address legal and ethical issues related to posttraumatic stress disorder (PTSD). In the first paper, Ronald Acierno and his colleagues describe the physiology, psychology, epidemiology, and symptomatic consequences of PTSD, as well as certain aspects of its treatment, including cognitive behavioral treatments and drugs.⁸ This survey of PTSD serves as the basis for discussion of legal and ethical implications of PTSD in the subsequent two papers.

Because most manifestations of PTSD are subjective and highly variable, its place in judicial proceedings has been at times contentious. The definition of PTSD has fluctuated ever since it was accepted as a formal diagnosis in 1980, and has changed to some degree in each successive edition of the Diagnostic and Statistical Manual of Mental Disorders, including DSM-5 in 2013. It is not surprising, therefore, that the use of PTSD in adjudicating violent crime has been controversial. Mark Hamner explores some of these conflicts as he describes judicial controversies related to opposing views of the nature of PTSD, and examines its diagnosis in both victims and perpetrators of violent crimes, as well

as in the special case of children.⁹ He also describes the current status of objective tests for the diagnosis of PTSD and their potential role in legal proceedings.

Possibly the most familiar example of PTSD is the occurrence of the syndrome in soldiers during active combat, which was first recognized in World War I, when it was termed “shell shock.” Treatment of PTSD in active combat soldiers today remains controversial. Bethany Wangelin and Peter Tuerk¹⁰ explore this controversy by addressing several questions: should soldiers who are successfully treated for PTSD be sent back into combat? If treatment near the battlefield is ineffective, can that attempt at treatment undermine later therapeutic efforts? Given military culture, if combat-zone treatment proves to be effective, should such treatment be mandatory? What unintended consequences might be associated with treatment outside of mental health care institutions? What role do genetic variations play in making decisions regarding treatment? The authors also address personal and social costs of not providing PTSD treatment.

The symposium closes with two discussions of an emotionally charged issue: treatment of the highly lethal brain tumor, glioblastoma multiforme. While providing background on the nature of the disease and its treatment, Nicholas Avgeropoulos and his colleagues discuss many of the medical, social, and ethical implications and controversies surrounding this disease.¹¹ Glioblastoma is extremely aggressive and lethal, with median survivals ranging from 14 weeks in conservatively treated patients to as much as 18 months with aggressive treatment consisting of surgery, radiation, and biochemotherapies. The authors examine the cost-effectiveness of treatment, emphasizing autonomous decision-making by the patient in the context of information about the physical, emotional, and financial costs of treatment. The authors discuss quality of life during and after treatment, pointing to its importance as a consideration in treatment decisions. They also emphasize the interdisciplinary aspect of care of these difficult patients, which includes psychosocial support and rehabilitation.

Continuing the focus on glioblastoma, Michael Gusmano addresses the finitude of resources for health care in decisions of whether or not to treat this brain tumor.¹² He explores the question of using age as a criterion for limiting curative care in the context of increasing health care costs, and goes on to discuss what it means to have had a “fair share” of life as a justification for rationing curative care in the elderly. He explores the ongoing debate on intergenerational justice, specifically, the transfer of financial resources between generations in the context of our aging population. He also discusses what he views as the real reasons for the high cost of health care costs in this country.

The aspects of brain science that are discussed in this symposium address only a very small number of the many controversial topics associated with this rapidly burgeoning field; the issues addressed here, however, are among the most contentious controversies. We hope that the discussions and viewpoints provided by the distinguished authors in this collection may shed light on the questions underlying these controversies, and perhaps will even provide some answers.

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