INSIDE VIEW

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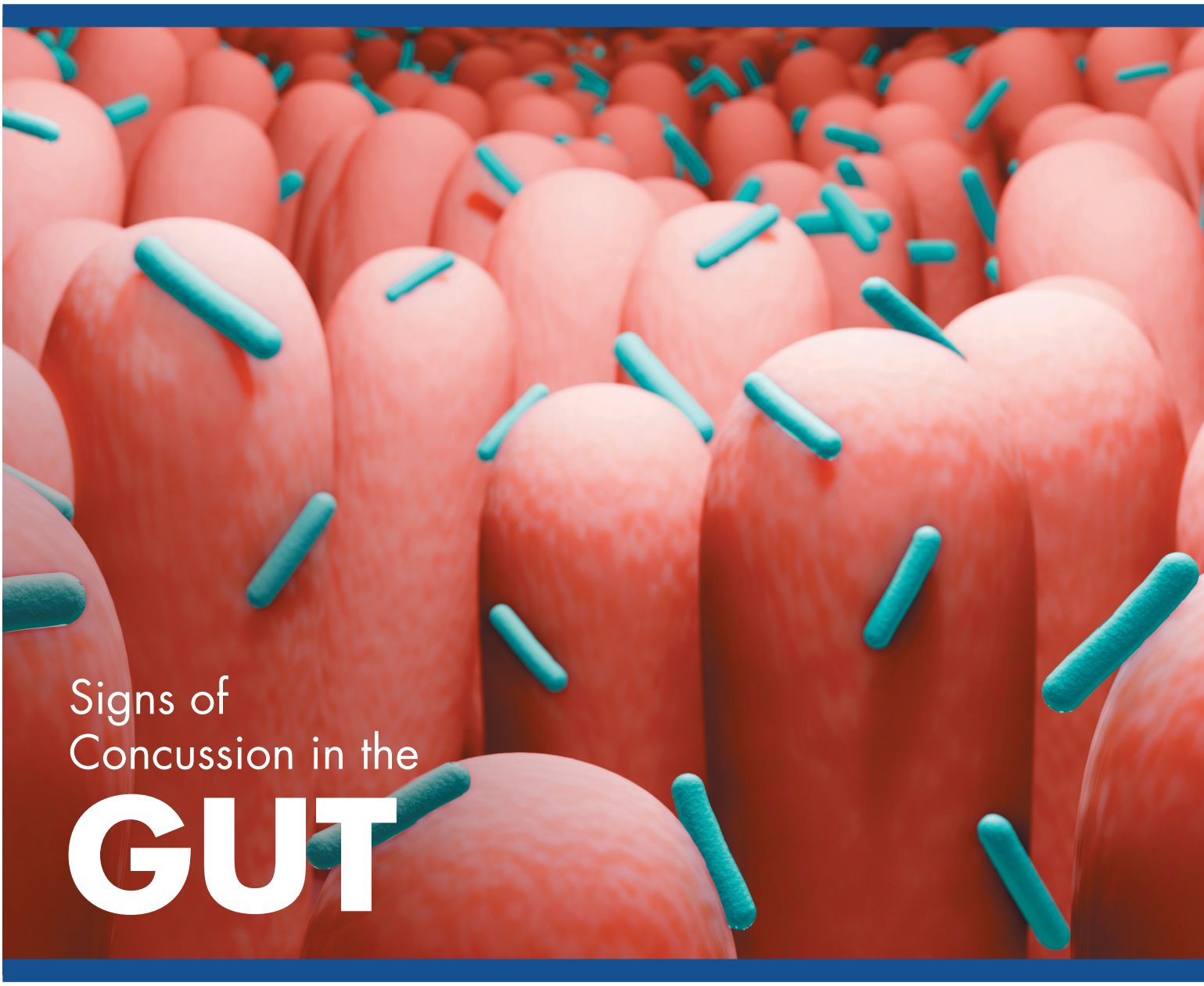

Signs of Concussion in the GUT

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Aphasia: Symptoms, Causes, Types, and Treatment

by Dr. Mark Ashley

Therapeutic treatment is best when initiated early and is of sufficient intensity and frequency and allowed to continue across several months, if needed.

Humans are endowed with the ability to communicate using language skills that develop in a spoken form, a listening form, a written form, and a gestural form. In most instances, people communicate with each other using a combination of these forms. Many people learn to use more than one language, while some learn several languages.

When a person experiences a stroke or an injury to the brain, the areas of the brain that enable us to speak, listen and understand, repeat words, phrases or sentences, and write and/or read can be damaged. Though related to one another, each of these skills is generally located in different areas of the brain. As a result, when the brain is injured, the effect on the ability to communicate is most likely to be largely restricted to one ability. For example, a common form of aphasia affects the ability to speak, that is, to use expressive language skills. Another type often seen affects the ability to understand what is said to a person, to use receptive language skills.

Eight types of aphasia have been identified. Of these, Broca's (expressive) and Wernicke's (receptive) aphasias are more commonly diagnosed. Several of the other types of aphasia share some similarities with these two, though they differ slightly, enabling finer discrimination. A person who has learned more than one language may have better skills in one language than another after the onset of aphasia, and their recovery may follow a similar pattern.

Primary progressive aphasia is the most difficult and persistent aphasia related to other underlying disease processes in the brain. This type of aphasia is most often permanent and worsens progressively over time in concert with the progression of underlying disease.

Diagnosis of aphasia is often made by a physician or by a speech-language pathologist. These two professionals work closely together to make a diagnosis and establish a treatment plan. Treatment for most aphasias consists of speech-language therapy. This long-standing therapy has been shown to be effective in improving a person's language abilities and developing compensatory ways to communicate. Some evidence exists for the use of certain medications in tandem with speech-language therapy to enhance the rate and extent of recovery. Therapeutic treatment is best when initiated early, is of sufficient intensity and frequency, and allowed to continue across several months, if needed.

One can expect some spontaneous recovery early after an injury to the brain; however, the extent of the recovery is hard to predict and varies due to several factors such as age, coexisting conditions, the extent and nature of the injury to the brain, and access to therapy. Therapy can include home therapeutic exercises for the person to complete with the help of a family member to increase the exposure to treatment.

Aphasia can be quite frustrating to the person with the condition and those with whom they wish to communicate. Communication is central to the human condition, and aphasia can bring about frustration, depression, anxiety, and isolation. The inability to communicate about one's health, psychological well-being, and safety matters can seriously impact the person with the condition or people in their environment.

Unfortunately, people with aphasia cannot always receive the necessary therapy needed to achieve their best outcome due to financial constraints or the availability of a speech-language pathologist. Organizations such as the American Stroke Association and the Brain Injury Association of America work to advocate for people with aphasia.

Finally, an excellent resource can be found in the American Speech-Language-Hearing Association. ■

2023 Calendar of Events

Jun

26-29
National Neurotrauma Society
2022 Symposium
Atlanta, GA
neurotrauma-symposium.org

Sep

21-24
Fourth International Conference on
Pediatric Acquired Brain Injury
New York, NY
internationalbrain.org/meetings-and-events/virtual-conference-2021

21-24
34th Annual Conference on Medical
and Legal Issues in Brain Injury
New York, NY
internationalbrain.org/meetings-and-events/2022-legal-and-medical-issue-in-brain-injury

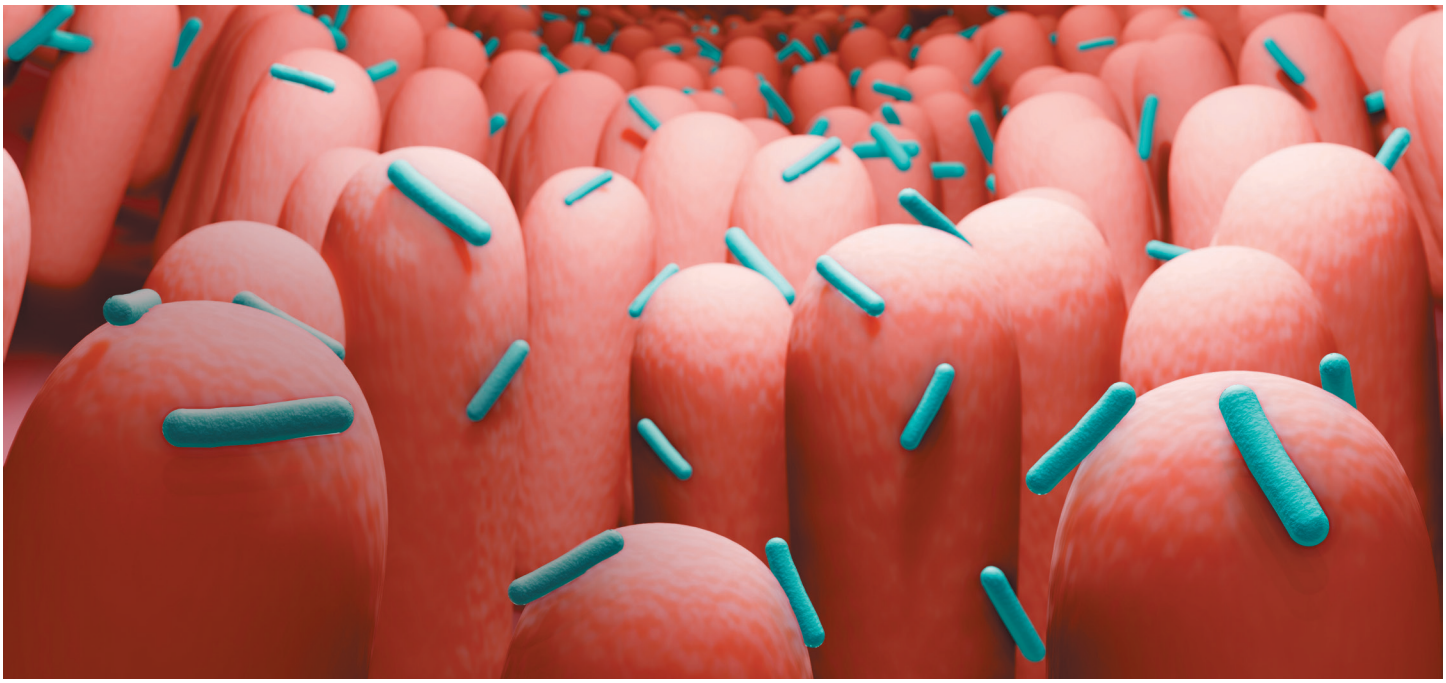
Nov

8-11
ACRM Annual Conference
Chicago, IL
acrm.org/meetings/

Mar 2023

29-1
14th Biennial World Congress
on Brain Injury
Dublin, Ireland
internationalbrain.org/meetings-and-events/ibia-world-congress

Articles are sourced from scientific journals, universities and publications that contribute to the ongoing research of brain injury.



Telltale Signs of Concussions May be Found in the Gut

After a concussion, injuries cause inflammation, sending small proteins and molecules circulating through the blood that breach the intestinal barrier and cause changes in the gut, affecting metabolism.

A recently published study by Houston Methodist scientists suggests telltale signs of concussions might be found in the gut. By taking blood, stool and saliva samples from 33 Rice University football players, the researchers were able to examine the diagnostic potential of the gut's microbiome. They say their findings demonstrate that a simple, objective diagnostic test could be developed to track the impact of concussions and signal when it's safe to return to action.

The findings of this study are described in a paper titled "Alterations to the gut microbiome after sport-related concussion in a collegiate football players cohort: A pilot study" appearing in the May issue of *Brain, Behavior, & Immunity – Health*, a peer-reviewed journal of the Psychoneuroimmunology Research Society with an emphasis on research that has translational impact and clinical implications. Sonia Villapol, Ph.D., an assistant professor of neurosurgery at the Center for Neuroregeneration in the Houston Methodist Research Institute, is the corresponding author on the study.

While brain movement within the skull may cause injury to nerve cells, such microscopic cellular injuries are not visible on imaging tests like X-rays, CT scans and MRIs, which are more capable of finding injuries on the scale of skull fractures, brain bleeding or swelling. So, the most commonly used test for diagnoses of concussions relies exclusively on self-reported symptoms like blurry vision, dizziness, nausea and headaches, which can be very vague, subjective and often underreported by athletes who want to continue playing. This can make them notoriously difficult to diagnose.

The study, conducted over the course of one season, found a post-concussion drop-off of two bacterial species normally found in abundance in stool samples of healthy individuals. It also found a correlation between traumatic brain injury linked proteins in the blood and one brain injury linked bacterial species in the stool.

While there have been dozens of brain injury biomarkers identified, there has been limited success in developing commercial blood tests sensitive enough to detect tiny increases in biomarker concentrations. However, the central nervous system is also intimately linked to the enteric nervous system, occurring in the intestines, and head trauma invariably leads to changes in the gut microbiota, Villapol said.

After a concussion, the injuries cause inflammation, sending small proteins and molecules circulating through the blood that breach the intestinal barrier and cause changes in the gut, affecting metabolism.

She said these changes in the microbiota could offer an opportunity to acquire a readout of the ongoing injury to the central nervous system.

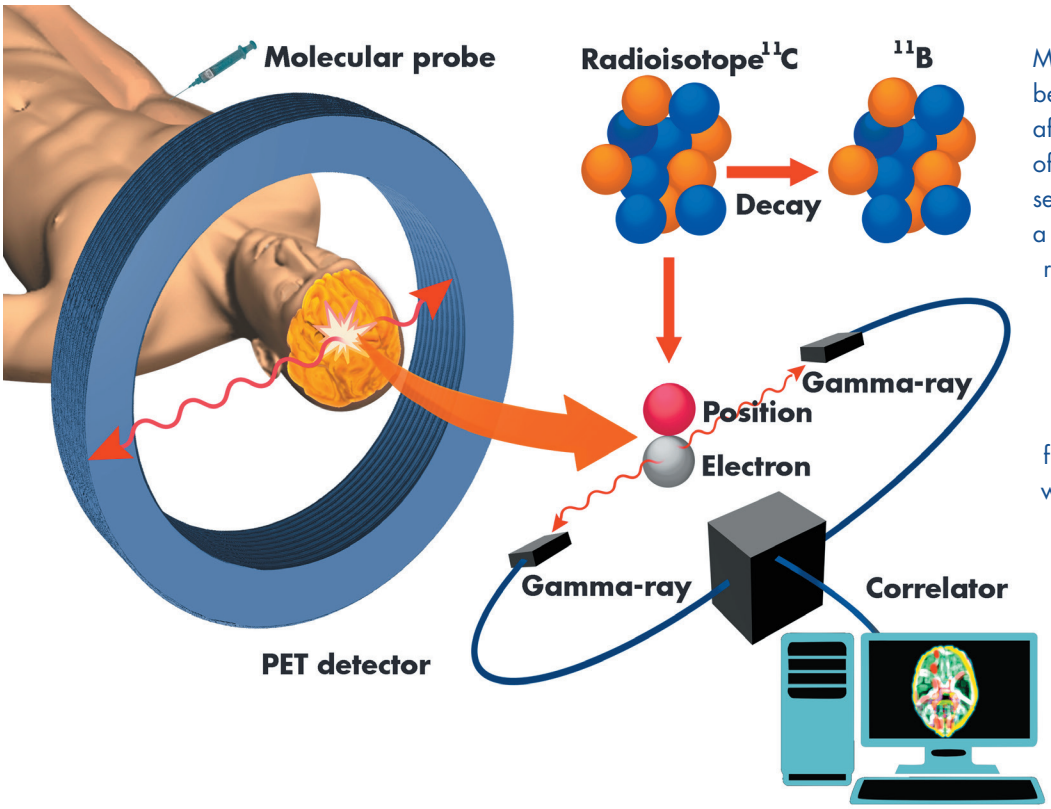
Until your gut microbiome has returned to normal, you haven't recovered. This is why studying the gut is so useful. It doesn't lie. And that is why there is so much interest in using it for diagnostic purposes."

Sonia Villapol, Ph.D., assistant professor of neurosurgery, Center for Neuroregeneration, Houston Methodist Research Institute

While only four of the players in the study were diagnosed with major concussions, the researchers say the results will need to be confirmed in a larger sample size. They also plan to conduct a similar study soon using women's soccer athletes, who similarly have frequent head trauma.

"Women and men don't have the same immunities or gut microbiomes, and as a woman and a mother of daughters, I would hate to be that researcher who only looks at men's issues while overlooking women," Villapol said. "Women soccer players have very high rates of concussions, as well, and all the same problems when it comes to existing diagnostic methods." ■

Until your gut microbiome has returned to normal, you haven't recovered. This is why studying the gut is so useful. It doesn't lie.



Molecular Imaging Uncovers Effects of COVID-19 on the Brain

A significant number of COVID-19 neurological complications – such as fatigue, headache, and cognitive impairment – are ultimately reversible, according to new research summarized by *The Journal of Nuclear Medicine*. The comprehensive literature review of molecular imaging findings sheds light on how COVID-19 affects the brain and identifies important implications for other neurological conditions, like Parkinson's disease or Alzheimer's disease.

Neurological symptoms are present in roughly two-thirds of hospitalized COVID-19 patients. Symptoms include fatigue, loss of smell, attention problems and memory loss. Patients who have more severe COVID-19 cases, are older, or have pre-existing conditions are more likely to experience these neurological issues.

Molecular imaging with PET or SPECT has been used to determine how COVID-19 affects the brain; however, these scans often show conflicting results. To make sense of the data, researchers conducted a comprehensive, systematic and critical review of molecular imaging studies in neuropsychiatric COVID-19 cases.

Their report was structured according to neurological symptoms and how they developed over time. The five symptoms included in the report were encephalitis, Parkinsonism and other neurodegenerative diseases, focal symptoms/lesions, encephalopathy, and post-COVID-19 syndrome. This helped the researchers to understand potential underlying (and most likely diverse) causes of the symptoms and to unravel discrepancies in the PET and SPECT literature.

"The presented studies are of high importance for patients struggling with neurological or cognitive aftermaths of COVID-19," said Philipp T. Meyer, MD, PhD, head of the Department of Nuclear Medicine of the Medical Center-University of Freiburg, in Freiburg, Germany. "To the best of our knowledge there are no convincing studies clearly demonstrating relevant and irreversible brain damage, except for disease complications like brain infarcts and bleedings. Thus, from our perspective, in the vast majority of cases there is no reason to assume that reported impairments will be permanent and not responsive to treatment."

What are the implications of this research for the future of molecular imaging of COVID-19 neurological symptoms? First, there is a clear need for further well-designed studies. "These need to be prospective, recruit larger patient cohorts, follow accepted syndrome or stage definitions, and use proper methodology," noted Jonas A. Hosp, MD, attending physician of the Department of Neurology and Clinical Neuroscience of the Medical Center-University of Freiburg, in Freiburg, Germany. "Carefully designed studies of COVID-19 populations will be of great interest moving forward."

Second, there are several potential clinical applications of molecular imaging in COVID-19 patients with cognitive or neurological impairment. "It may be the case that COVID-19 unmasked or hastened a pre-existing neurodegenerative disease like Parkinson's or Alzheimer's," said Meyer. "Molecular imaging could be used to identify these patients." ■

Study Finds Increased Risk of Dementia After Hospitalization for Major TBI

People who have been hospitalized for a major traumatic brain injury (TBI) may have a higher risk of developing dementia when compared to people who do not have a TBI, according to a new study published in *Neurology®*, the medical journal of the American Academy of Neurology. Major TBI was defined as having bleeding in the brain and a hospital stay of three or more days. Researchers did not find an increased risk for people who had minor TBI, which was defined as a concussion with no more than a one-day hospital stay.

"Traumatic brain injury has been identified as a possible risk factor for dementia, and due to increasing numbers of people living with dementia, it is imperative to identify risk factors that might be modifiable to decrease the number of people who develop dementia in the future," said study author Rahul Raj, MD, PhD, of the University of Helsinki in Finland. "The goal of our study was to assess the association between TBI and dementia while adjusting for other relevant dementia risk factors like high blood pressure, smoking, alcohol consumption and physical activity."

For the study, researchers used a Finnish national database that includes health surveys collected every five years. Focusing on a 20-year period, they identified 31,909 people who completed one or more surveys that included details on lifestyle factors such as physical activity, smoking and alcohol use.

Researchers then looked at national health registries. Of the study group, they identified 288 people hospitalized due to a major TBI and 406 hospitalized due to a minor TBI who did not have dementia within one year of their injury. A total of 976 people developed dementia over an average 16-year follow-up period.

Of those with a major TBI, 27 people, or 9%, developed dementia. Of those with a minor TBI, nine people, or 2%, developed dementia. And of those with no TBI, 940 people, or 3% developed dementia.

After adjusting for age and sex, researchers found that people who were hospitalized due to a major TBI had a 1.5 times greater risk of dementia than those without a TBI.

But after further adjustment for other relevant dementia risk factors such as education, smoking, alcohol consumption, physical activity and high blood pressure, the association weakened. Raj explained that alcohol use and physical activity appeared to play the biggest role in weakening the association.

Researchers found no increased risk of dementia for people hospitalized for minor TBI.

"Approximately one in 10 people in our study who had major TBI did develop dementia," said Raj. "Considering that there is no cure for dementia or TBI, the results of our study suggest that prevention of other dementia risk factors such as excess alcohol consumption and physical inactivity could possibly reduce the risk of dementia in people with major TBI. More research is needed in larger groups of people."

A limitation of the study was that it included only people hospitalized for TBI, so people who did not seek care for a mild TBI were not included. ■

"The goal of our study was to assess the association between TBI and dementia while adjusting for other relevant dementia risk factors like high blood pressure, smoking, alcohol consumption and physical activity."

Harnessing the Immune System to Treat Traumatic Brain Injury

"We sought to design a new therapeutic to boost the population of regulatory T cells in the brain, so that they could manage inflammation and reduce the damage caused by traumatic injury."

A therapeutic method for harnessing the body's immune system to protect against brain damage is published today by researchers from the Babraham Institute's Immunology research program. The collaboration between Professor Adrian Liston (Babraham Institute) and Professor Matthew Holt (VIB and KU Leuven; i3S-University of Porto) has produced a targeted delivery system for boosting the numbers of specialized anti-inflammatory immune cells specifically within the brain to restrict brain inflammation and damage. Their brain-specific delivery system protected against brain cell death following brain injury, stroke and in a model of multiple sclerosis. The research is published in the journal *Nature Immunology*.

Traumatic brain injury, like that caused during a car accident or a fall, is a significant cause of death worldwide and can cause long-lasting cognitive impairment and dementia in people who survive. A leading cause of this cognitive impairment is the inflammatory response to the injury, with swelling of the brain causing permanent damage. While inflammation in other parts of the body can be addressed therapeutically, but in the brain, it is problematic due to the presence of the blood-brain barrier, which prevents common anti-inflammatory molecules from getting to the site of trauma.

Prof. Liston, a senior group leader in the Babraham Institute's Immunology program, explained their approach: "Our bodies have their own anti-inflammatory response, regulatory T cells, which have the ability to sense inflammation and produce a cocktail of natural anti-inflammatories. Unfortunately, there are very few of these regulatory T cells in the brain, so they are overwhelmed by the inflammation following an injury. We sought to design a new therapeutic to boost the population of regulatory T cells in the brain, so that they could manage inflammation and reduce the damage caused by traumatic injury."

The research team found that regulatory T cell numbers were low in the brain because of a limited supply of the crucial survival molecule interleukin 2, also known as IL2. Levels of IL2 are low in the brain compared to the rest of the body as it can't pass the blood-brain barrier.

Together the team devised a new therapeutic approach that allows more IL2 to be made by brain cells, thereby creating the conditions needed by regulatory T cells to survive. A 'gene delivery' system based on an engineered adeno-associated viral vector (AAV) was used: this system can actually cross an intact blood brain barrier and deliver the DNA needed for the brain to produce more IL2 production.

Commenting on the work, Prof. Holt, from VIB and KU Leuven, said: "For years, the blood-brain barrier has seemed like an insurmountable hurdle to the efficient delivery of biologics to the brain. Our work, using the latest in viral vector technology, proves that this is no longer the case; in fact, it is possible that under certain circumstances, the blood-brain barrier may actually prove

to be therapeutically beneficial, serving to prevent 'leak' of therapeutics into the rest of the body."

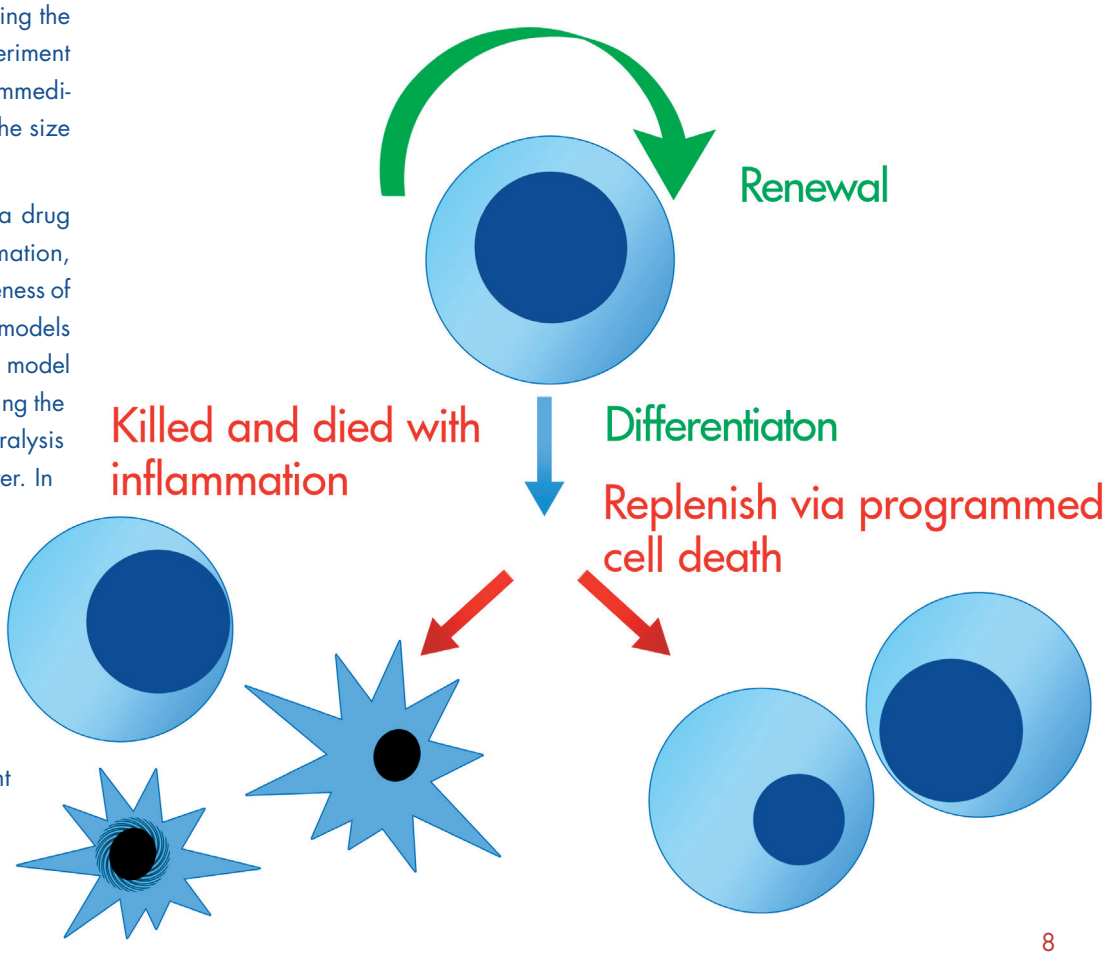
The new therapeutic designed by the research teams was able to boost the levels of the survival molecule IL2 in the brain, up to the same levels found in the blood. This allowed the number of regulatory T cells to build up in the brain, up to 10-fold higher than normal. To test the efficacy of the treatment in a mouse model that closely resembles traumatic brain injury accidents, mice were given carefully controlled brain impacts and then treated with the IL-2 gene delivery system. The scientists found that the treatment was effective at reducing the amount of brain damage following the injury, assessed by comparing both the loss of brain tissue and the ability of the mice to perform in cognitive tests.

Lead author, Dr Lidia Yshii, Associate Professor at KU Leuven, explained: "Seeing the brains of the mice after the first experiment was a 'eureka moment' – we could immediately see that the treatment reduced the size of the injury lesion."

Recognizing the wider potential of a drug capable of controlling brain inflammation, the researchers also tested the effectiveness of the approach in experimental mouse models of multiple sclerosis and stroke. In the model of multiple sclerosis, treating mice during the early symptoms prevented severe paralysis and allowed the mice to recover faster. In a model of stroke, mice treated with the IL2 gene delivery system after a primary stroke were partially protected from secondary strokes occurring two weeks later. In a follow-up study, still undergoing peer review, the research team also demonstrated that the treatment was effective at preventing cognitive decline in ageing mice.

"By understanding and manipulating the immune response in the brain, we were able to develop a gene delivery system for IL2 as a potential treatment for neuroinflammation. With tens of millions of people affected every year, and few treatment options, this has real potential to help people in need. We hope that this system will soon enter clinical trials, essential to test whether the treatment also works in patients." said Prof. Liston.

Dr Ed Needham, a neurocritical care consultant at Addenbrooke's Hospital who was not a part of the study, commented on the clinical relevance of these results: "There is an urgent clinical need to develop treatments which can prevent secondary injury that occurs after a traumatic brain injury. Importantly these treatments have to be safe for use in critically unwell patients who are at high risk of life-threatening infections. Current anti-inflammatory drugs act on the whole immune system and may therefore increase patients' susceptibility to such infections. The exciting progress in this study is that, not only can the treatment successfully reduce the brain damage caused by inflammation, but it can do so without affecting the rest of the body's immune system, thereby preserving the natural defenses needed to survive critical illness." ■



A Pathway to Better Understand the Return of Consciousness After TBI

The return of consciousness after traumatic brain injury (TBI) remains something of a mystery for scientists and is not easy to predict. A series of recently published studies by researchers in the Department of Neurosurgery at the Renaissance School of Medicine at Stony Brook University has found that by using technologies to monitor brain functions after TBI, scientists may be able to better predict who will "wake up" after TBI and what brain circuits to target to potentially treat disorders of consciousness.

Humans are capable of an infinite variety of behaviors, so short-term prediction of human behavior is impossible. By studying brain injury patients in detail, co-authors Sima Mofakham, PhD, Assistant Professor in the Department of Surgery and the Department of Electrical and Computer Engineering, and Charles Mikell, MD, Assistant Professor in the Department of Neurosurgery, have identified the brain circuits required for unpredictable behavior, which they think is a core feature common to human consciousness. Their research involves colleagues within their jointly run Neurosurgery laboratory, and collaborators nationally.

Summarizing the compilation of the research and this situation with TBI patients, Dr. Mofakham explains: "This predictability is apparent in patients' brain signals that we recorded with special electrodes on the scalp and the brain. By studying brain injury patients in this state, we have identified the brain circuits required for unpredictable behavior. Specifically, we found that injuries to a brain region called the thalamus results in 'attractor dynamics' in the brain. 'Attractors' are ways of describing repetitive activity, which the brain has trouble escaping, like trying to escape a whirlpool. The thalamus is a walnut-sized piece of brain tissue that coordinates activity in other parts of the brain.

"For cortical networks, attractors limit the availability of different brain states, and consequently behaviors. We found the integrity of the thalamocortical connections may support the behavioral and electrophysiological unpredictability associated with consciousness."

The first paper, published in Communications Biology, involved using electrodes implanted in the brain to look at brain dynamics in comatose patients as they recovered consciousness following brain injury. This use of implanted (depth) electrodes made this the first study of its kind and opened a new window into brain dynamics after injury in comatose patients. They assessed five patients in a unique study that combined brain wave recording with brain imaging in an attempt to understand how thalamus injury affects cortical function.

Their main finding was that thalamus input facilities the formation of cortical ensembles required for the return of cognitive function and consciousness. This observation supports the view that thalamic input to the cortex enables rich cortical dynamics associated with consciousness.

In a paper published in Progress in Neurobiology, Drs. Mofakham and Mikell, and their colleagues, found in another cohort of patients (n = 15) that the number of cortical states is limited, and brain activity is predictable in patients with injuries to their thalamus and its projections to the cortex. They found that withdrawal of thalamic input results in a cortical attractor state with a limited number of states available, which leads to limited behaviors.

They write that the "results are in line with the new view of the thalamus: the thalamus is not simply a relay center, but it can dynamically control the distributed adaptive dynamics within and across cortical networks to

"After brain injury, unconscious and semi-conscious patients don't do much, they don't engage in goal-oriented behavior, and their behaviors are highly predictable."

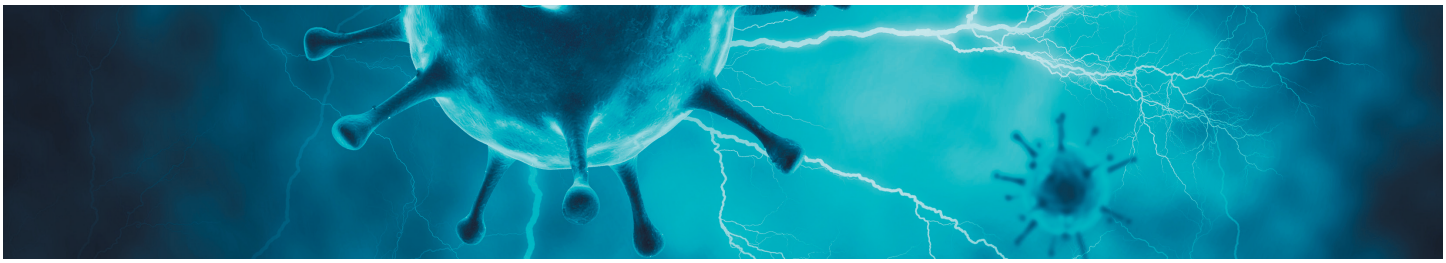
Dr. Charles Mikell, MD, Assistant Professor, Department of Neurosurgery, Stony Brook University

support the ongoing cognitive task. Multiple reports support this view and define a new role for the thalamus, in particular higher-order thalamic nuclei such as the mediodorsal nucleus, as the regulator of connectivity."

Research published in Frontiers in Neurology showed that people with thalamic injury and injuries to their mediodorsal nucleus, are less likely to recover the content of consciousness. This study involved analyzing 25 patients after severe TBI. They investigated whether the integrity of the thalamo-prefrontal circuits, assessed via diffusion tensor imaging, was associated with the return of goal-oriented behavior.

Some patients recovered, but some did not, and more than half returned to a state where they could follow commands or engage in other goal-oriented behavior. All of the researchers' data from their imaging and testing of patients supported that intact thalamo-prefrontal connectivity was essential to the return to goal-oriented behavior.

Overall, the investigators have provided a pathway to better understand the brain and recovery post TBI. ■



Study Shows COVID-19's Lingering Impacts on the Brain

COVID-19 patients commonly report having headaches, confusion and other neurological symptoms, but doctors don't fully understand how the disease targets the brain during infection.

Now, researchers at Tulane University have shown in detail how COVID-19 affects the central nervous system, according to a new study published in *Nature Communications*.

The findings are the first comprehensive assessment of neuropathology associated with SARS-CoV-2 infection in a nonhuman primate model.

The team of researchers found severe brain inflammation and injury consistent with reduced blood flow or oxygen to the brain, including neuron damage and death. They also found small bleeds in the brain.

Surprisingly, these findings were present in subjects that did not experience severe respiratory disease from the virus.

Tracy Fischer, PhD, lead investigator and associate professor of microbiology and immunology at the Tulane National Primate Research Center, has been studying brains for decades. Soon after the primate center launched its COVID-19 pilot program in the spring of 2020, she began studying the brain tissue of several subjects that had been infected.

Fischer's initial findings documenting the extent of damage seen in the brain due to SARS-CoV-2 infection were so striking that she spent the next year further refining the study controls to ensure that the results were clearly attributable to the infection.

"Because the subjects didn't experience significant respiratory symptoms, no one expected them to have the severity of disease that we found in the brain," Fischer said. "But the findings were distinct and profound, and undeniably a result of the infection."

The findings are also consistent with autopsy studies of people who have died of COVID-19, suggesting that nonhuman primates may serve as an appropriate model, or proxy, for how humans experience the disease.

Neurological complications are often among the first symptoms of SARS-CoV-2 infection and can be the most severe and persistent. They also affect people indiscriminately – all ages, with and without comorbidities, and with varying degrees of disease severity.

Fischer hopes that this and future studies that investigate how SARS-CoV-2 affects the brain will contribute to the understanding and treatment of patients suffering from the neurological consequences of COVID-19 and long COVID. ■

Study Shows Prevalence and Misdiagnosis of Post-Concussive Syndrome in Children after Mild Head Injury

A new study by Tel Aviv University, Kaplan Medical Center and Shamir Medical Center (Assaf Harofeh) found that one in four children (25.3%) who have been discharged from the emergency room after a mild head injury are misdiagnosed and continue to suffer from persistent post-concussion syndrome for many years. This syndrome includes chronic symptoms such as forgetfulness, memory problems, sensitivity to light and noise, ADHD and even psychological problems and, instead of receiving treatment for the syndrome, they are mistakenly diagnosed as suffering from ADHD, sleep disorders, depression, etc. The misdiagnosis leads to treatment that is not suited to the problem, thus causing the children prolonged suffering.

The study was led by Prof. Shai Efrati of the Sagol Center for Hyperbaric Medicine and Research at Tel Aviv University and Shamir Medical Center (Assaf Harofeh), Dr. Uri Bella and Dr. Eli Fried of Kaplan Medical Center, and Prof. Eran Kotzer of Shamir Medical Center. The results of the study were published in the journal Scientific Reports.

"The objective of our study was to determine how many children in Israel suffer from persistent post-concussion syndrome," says Dr. Fried of Kaplan Medical Center. "The children participating in the study arrived at the emergency room with mild head trauma and, after staying overnight for observation or being sent for a CAT scan of the head, they were discharged to go home."

Prof. Efrati of Tel Aviv University states: "Persistent post-concussion syndrome is a chronic syndrome that results from micro damage to the small blood vessels and nerves, which may appear several months after the head injury, and therefore is often misdiagnosed as attention deficit disorders, sleep disorders, depression, etc. There are cases where children report headaches and are diagnosed as suffering from migraines or, for example, children who report difficulty concentrating and the doctor prescribes Ritalin. Unfortunately, these children continue to suffer for many years from various disorders and, instead of treating the real problem, which is the syndrome, they receive treatments that usually do not solve the problem."

The study examined 200 children who suffered from a head injury and who were released from the emergency room after the need for medical intervention was ruled out. The researchers tracked the subjects for a period between six months and three years from their date of discharge and found that about one in four children released from the emergency room suffered from the chronic syndrome.

It should be understood that the consequences of brain injury during childhood continue throughout life. Loss of any brain function will prevent the child from realizing his or her potential in education and in social life."

Dr. Uri Bella, Director of the Pediatric Emergency Room, Kaplan Medical Center

Unlike damage to large arteries and noticeable damage to brain tissue, with a minor head injury, the damage is to the small blood vessels and neurons – and it is not detected on CAT scans of the head or on regular MRIs. Diagnosis of the syndrome requires long-term

monitoring of the manifestation of symptoms as well as the use of imaging and functional tests of the brain. According to the researchers, the alarming findings demonstrate that changes in the approach are needed to be monitoring and treating these children.

"The purpose of an emergency room diagnosis is to determine whether the child suffers from a severe brain injury that requires immediate medical intervention," adds Prof. Eran Kotzer, Director of the Emergency Rooms at the Shamir Medical Center. "Unfortunately, the way most medical systems operate today, we miss long-term effects and do not continue to monitor those children who leave the emergency room without visible motor impairment."

"Treatment for a wide range of disorders will change if we know that the cause of the new problem is a brain injury," concludes Prof. Efrati. "Proper diagnosis of the cause is the first and most important step in providing appropriate treatment for the problem." ■

Persistent post-concussion syndrome may appear several months after the head injury and is often misdiagnosed as attention deficit disorders, sleep disorders, depression, etc.

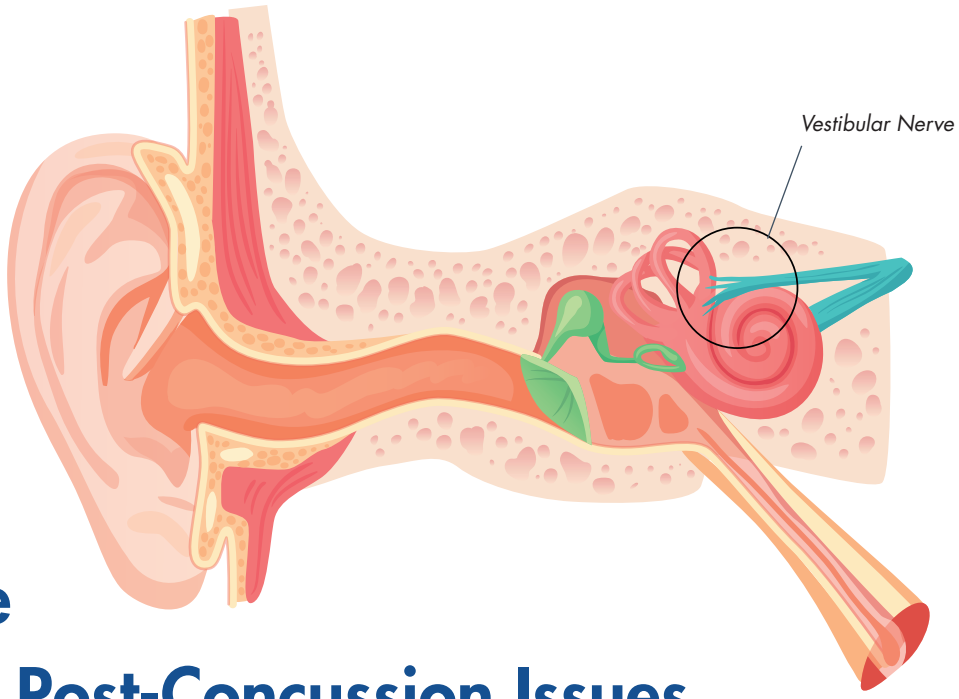
Traumatic Brain Injury May Up Risk for Developing Comorbidities

Traumatic brain injury (TBI) of any severity is associated with increased risk of chronic cardiovascular, endocrine, and neurologic comorbidities, according to a study recently published in JAMA Network Open.

Saef Izzy, M.D., from Brigham and Women's Hospital in Boston, and colleagues conducted a longitudinal cohort study using hospital-based patient registry data to examine the incidence of cardiovascular, endocrine, neurological, and psychiatric comorbidities in patients who experienced mild TBI (mTBI) or moderate-to-severe TBI (msTBI) from 2000 to 2015. Patients were matched to an unexposed group without head injuries. The analyses included 4,351 patients with mTBI, 4,351 with msTBI, and 4,351 unexposed individuals.

The researchers found that compared with unexposed individuals, those with mTBI and msTBI had significantly higher risks of cardiovascular, endocrine, neurologic, and psychiatric disorders. In particular, in both mTBI and msTBI groups, hypertension risk was increased (hazard ratios, 2.5 and 2.4, respectively); the risk of diabetes was also increased in both groups (hazard ratios, 1.9 and 1.9, respectively), as was the risk of ischemic stroke or transient ischemic attack (hazard ratios, 2.2 and 3.6, respectively). In the TBI subgroups, all comorbidities emerged within a median of 3.49 years after injury. The risk of mortality was increased for individuals with msTBI versus unexposed individuals (9.9 versus 5.7 percent); increased mortality was seen in association with postinjury hypertension, coronary artery disease, and adrenal insufficiency (hazard ratios, 1.3, 2.2, and 6.2, respectively).

"These findings suggest a need for proactive screening of chronic systemic diseases after brain injury of any severity," the authors write. ■



Damaged Nerve Behind Athletes' Post-Concussion Issues

Depression, dizziness, difficulty focusing the gaze and balance problems. Many professional athletes who have sustained head trauma in sports have lingering symptoms that affect everyday life. Little help has been available as the cause has been unknown. A clinical study from Lund University in Sweden can now show that the problems originate in an injury to the vestibular nerve.

Athletes in contact sports such as ice hockey, football and skiing have an increased risk of sustaining a head injury. If the impact is severe enough, the athlete can suffer a concussion. Even minor head injuries can have serious consequences. The problems have been brought to light within American football, where players who have suffered from repeated concussions have developed dementia, severe depression and cognitive impairment.

In many cases, the symptoms after a concussion are temporary, but an increasing number of athletes experience long-term problems that make it difficult to work, go to school or play sports. The symptoms are aggravated by activity or impressions and include headaches, depression, anxiety, nausea, difficulty focusing and problems with balance.

"It has been unclear what causes the symptoms, and it is difficult for healthcare professionals to help these athletes. We wanted to investigate this further to find out what really causes the symptoms," says Niklas Marklund, professor of neurosurgery at Lund University, consultant at Skåne University Hospital with a scientific interest in sports-related head injuries and one of the researchers behind the article.

A total of 42 people were included in the study. One group included 21 healthy athletes without previous trauma to the head, and the other 21 athletes who all suffered from sports-related concussions and who had experienced persisting symptoms for more than six months. All the participants underwent various tests in which the researchers examined, among other things, their balance organs. Using a so-called 7-Tesla MRI, the athletes' brains were studied to understand more about what caused the symptoms. The researchers found impaired function of the balance organs in the inner ear of 13 athletes in the group with long-term problems. In the group of healthy athletes 3 people had similar findings.

"The test results show that the injury is located to the vestibular nerve, which is connected to the semicircular canals in a cavity inside the skull, and which is directly adjacent to the cochlea in the ear. These injuries lead to the inward nerve impulses not working properly, and the brain therefore does not receive important information about body movements and sensory impressions required to maintain a good balance," says Anna Gard, doctoral student at Lund University, resident in neurosurgery at Skåne University Hospital and first author of the study.

When you suffer from a concussion, it is often because the head rotates too fast, for example when tackling in ice hockey.

"We have not examined athletes with short-term problems after blows to the head, so we cannot say anything about them. This study applies to athletes with prolonged symptoms after concussion. The rotation of the head that occurs in connection with a concussion could lead to a stretch of the vestibular nerve, which then leads to impaired function. Now that we have more knowledge about where the problems are located, it is easier to find possible therapies that could help these athletes," concludes Niklas Marklund. ■

Gender Differences Found in Long-Term Impact of Mild Concussions

A team of researchers from the University of Waikato, Auckland University of Technology and the University of Auckland, all in New Zealand, has found that women tend to experience more long-term negative impacts from mild concussions than men. In their paper published on the open-access site PLOS ONE, the researchers describe their study of people across New Zealand who had experienced one or more concussions and the symptoms they were experiencing eight years later.

As the team notes, a lot of research has been done on moderate and severe traumatic brain injury (TBI) but little has been done to learn about the health implications of those who experience mild TBI. Some research has suggested that people who experience a mild TBI can have lingering symptoms and that mild concussions can lead to ailments such as heightened anxiety, PTSD or difficulties in carrying out job responsibilities.

To learn more about the fate those who experience mild TBI events, the researchers obtained data from the BIONIC study for participants during the years 2010 and 2011. In analyzing the data, they found 1,298 people who had experienced a mild TBI, of which just 346 had completed a survey regarding their symptoms and 151 of those who had completed a follow-up survey eight years later.

In looking at the data, the researchers found that approximately one third of those who had completed the second survey reported experiencing negative associated symptoms eight years later. They also found something unexpected; women seemed to fare worse than men. Women with mild TBI events were twice as likely to experience PTSD or other health problems that they believed were related to their concussion, than were men. They also found that women who had experienced more than one TBI event were more adversely impacted than were men who had multiple events or women who had experienced only one event.

The researchers conclude by suggesting that injury management for people with mild TBI events needs to be improved, both in the short and long term. They also suggest that people who experience such events should also be treated for mental health problems that may arise due to their injury. ■

INSIDE VIEW
A Quarterly Magazine Dedicated to the Field of Acquired Brain Injury

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