CHAPTER 1

PEDIATRIC TRAUMATIC HEAD INJURIES

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Abstract: With the rapid development of neuroimaging and neuroscience in the past several years, the body of research and clinical knowledge about concussion processes in adults continues to rapidly increase. Nevertheless, many questions involving the functioning of a human brain post-head injury and its recovery remain unanswered. There is even less known about neurodynamics of concussive processes and recovery in children, whose young brain remains in a state of constant developmental change. There is enormous amount of variations, which are introduced in to the picture of pediatric concussion, that have to do with the child’s brain developmental phase at the time of the injury, its capacity for plasticity and adaptation to TBI, and other factors. This chapter attempts to provide an overview of research and clinical data relevant to the complex interplay of a child’s developing brain and the effects of a mild head injury. There is a growing body of research suggesting that even mild head injuries produce significant neurocognitive and neurobehavioral deficits in children and adolescents. As elucidated below, there is some uncertainty and controversy in regards to the definition, sequelae of, and recovery from pediatric concussions. The review of literature supports the idea that concussive processes produce a unique profile of neurocognitive and neurobehavioral deficits that is different for each child, given his developmental phase at the onset of injury and pre- and post-injury characteristics. The role of a comprehensive neuropsychological examination in detection of these deficits is substantial, as it delineates child’s unique profile of strengths and weaknesses that are essential for effective treatment planning and adequate academic placement.

Keywords: pediatric concussion; neuropsychology; assessments; head injury; neuro-cognitive and neuro-behavioral deficits; seizures; developmental plasticity.

1. INTRODUCTION

With the rapid development of neuroimaging and neuroscience in the past several years, the body of research and clinical knowledge about concussion processes in adults continues to rapidly increase. Nevertheless, many questions involving the functioning of a human brain post-head injury and its recovery remain unanswered. We continue our
relentless inquiry to find the threshold of damage in the adult brain, what
the biological predispositions to more severe residuals of head injury are,
and what the optimal period of time required for a full recovery is. These
are just some of the questions that many researchers struggle to unravel in
order to understand the nuances of neurochemistry and neurodynamics of
a concussion. We hope that gaining more knowledge in these areas will
allow us to influence this process at an earlier stage in an attempt to stop
the process of brain tissue damage and to speed up its recovery.
However, many research studies that hold great potential for the future of
head injury prevention and treatment are still at the stage of animal
models. Moreover, most of our knowledge about concussive processes in
a human brain involves an adult brain, which has completed its
developmental cycle and does not offer much variation in terms of
anatomical and functional plasticity. There is even less known about
neurodynamics of concussive processes and recovery in children, whose
young brain remains in a state of constant developmental changes. There
is an enormous amount of variation, introduced in to the picture of
pediatric concussion that has to do with the brain’s developmental phase
at the time of the child’s injury, its capacity for plasticity and adaptation
to the injury, and other factors. This issue becomes even more
complicated when we attempt to determine the effects of mild head injury
on a still developing young brain. As discussed below, there is some
uncertainty in regards to the definition and the effects of mild head injury
on adult brain and even more on a child brain. Moreover, there are
methodological issues in regards to the outcome measures of post-injury
recovery. This is due to the fact that the brain is still developing and,
therefore, must simultaneously cope with overcoming the challenges of
the cerebral insult and to meet the demands of normal development. For
instance, in case of an adult onset of head injury, the outcomes of
recovery are measured based on already established neurocognitive
abilities. However, in case of a young brain, the outcome is determined
by the recovery of established and newly acquired abilities.

While the extent of our knowledge of pediatric concussive processes
is much less than the knowledge of this type of injury in adults, the rate of
concussion among children and adolescents appears to be greater than
that of adults. In fact, while researchers focus mainly on adults when
investigating sport related concussions, overall, children and adolescent
athletes represent the largest athlete group across many sports. The
statistics are alarming, as millions of children are being injured in motor
vehicle accidents and in sports, as well as other recreational activities.
Nation-wide surveys show that children are also very likely to get injured
as a result of falls involving bicycles, swings, playground structures,
toddler walkers, stairs and etc. In fact, according to the Central Disease
Control, children from 6 to 14 years have a higher risk of sustaining a