A Case Report of Impaired Driving Performance after a Concussion

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INTRODUCTION

The effects of a concussion on executive function, including attention, reaction time, and memory as well as saccadic eye movement are well documented.[1-4] Successful driving relies on the coordination of cognitive and visual functions.[5] This is the basis of the recommendation from the CDC that concussed patients refrain from driving. However, studies that qualify the deficits that occur as a result of a concussion or quantify the magnitude or timeliness of these deficits have not been done. Here we present a case of a collegiate female athlete whose driving performance after a concussion was demonstrated objectively and use this information to underscore the importance of studying the effects of concussion on driving safety.

CASE REPORT

An 18-year old collegiate athlete was playing hockey with her team when she struck her head against the ice while wearing a helmet. There was no loss of consciousness. She was removed from the game, due to immediate onset of headache, nausea, and a sensation of dizziness. On physical exam, she had no external signs of trauma and had no midline C-spine tenderness or neck movement limitations. She had normal mental status, was oriented and could easily recall three-objects immediately and when subsequently asked five minutes later. She had no focal neurologic deficits. She stumbled and opened her eyes during balance testing. She was diagnosed with a concussion using the Sports Concussion Assessment Tool Edition 3 (SCAT-3). The athlete was an otherwise healthy patient with no prior concussions.

Prior to the start of the hockey season, the patient had completed both a test of baseline cognitive ability and executive function (Trail Making Test, Part B)[6] as well as a driving simulator evaluation (Virtual Driver Interactive, dVT29® simulator utilizing StreetReady® software). This baseline driving testing included a 10-minute practice course in the driving simulator, followed by a 10-minute simulated driving course that was scored. Each driving infraction, classified as minor or severe, affected the overall score. Minor infractions included failure to stop at a stop sign, not using turn signals, and not obeying posted speed limits. More serious infractions included colliding with another motor vehicle or pedestrian and resulted in an instant failure. The number and types of infractions and a computer generated pass/fail grade was recorded for the patient.

To assess the correlation between symptom and cognitive recovery and driving ability, both the TMT-B and the simulated driving were repeated every 48 hours until the patient was cleared to return to sport.

The preseason tests (neuropsychological and driving simulator) served as her baseline. Within 48 hours of the injury the subject was found to have changes in gross driving performance (e.g., lane change errors, errors in speed and vigilance) and a significant decline in Trails B performance relative to her baseline. Specifically, the number of her driving infractions increased from 7 at the baseline test to 15 post-injury and her scores on the TMT-B went from 32.8 seconds at baseline to 41 seconds at 48 hours (a 25% increase in time to complete). The tests were repeated at the end of the season and at this time, her TMT-B score was 34.1 seconds. The TMT-B and the driving simulator were completed by 23 other hockey players pre-season and post season. The mean number of driving infractions at baseline was 2.4 (SD = 3.1), and 2.7 (SD = 3.9) at the post season test while the mean preseason TMT-B times were 52.6s (SD =22.5) and the post-season mean was 39.9 (SD = 13.01). It was noted that our patient had a higher number of driving infractions at baseline, the relevance of which is not clear.

DISCUSSION

Sports-related concussion (SRC) is the most common injury reported in athletes, representing 11.6% of all high school athletic injuries[7] and 5.8% of all collegiate athletic injuries.[8] A concussion results in decreased reaction time, attention,[2] verbal and visual memory,[3] as well as alterations in impulse control, processing speed, and executive function, including task switching behavior.[4] Driving is a complex cognitive and behavioral activity that relies on the coordination of all of these processes and is therefore affected by this injury.

The confluence of impaired neurocognitive and visual ability following a concussion and the increased risks of accidents by young drivers[9] is an important public safety concern. Currently, there are no evidence-based clinical guidelines informing restrictions in driving behaviors that should be initiated following a concussion.

Two studies in Australia[10,11] suggested that driving should

be restricted in those suffering from a concussion. The first focused on the ability of concussed patients to recognize road hazards. Within the first 24 hours of sustaining a concussion, patients were not able to identify road hazards in a video sequence when compared to age-matched controls. In a separate survey study, the same authors found that patients who had sustained a concussion did not intend to change their driving frequency as a result of the head injury. Schmidt and colleagues used a driving simulator to investigate the driving abilities in recently concussed patients compared to age and driving-experience matched controls.[12] Recently concussed patients were defined as those patients having met the definition for concussion, but were asymptomatic 48 hours later. Using a driving simulation test they evaluated accidents, minor infractions that would normally result in a ticket (such as speeding), lane excursions, velocity, and lane position and found that recently concussed patients were less likely to center the vehicle in the lane and entered the shoulder more frequently. The conclusion from these studies was that concussed patients should be counseled to refrain from driving and that the effects of a concussion may impair driving abilities even beyond the symptomatic phase.

However, to date, research regarding driving while concussed has lacked the research paradigm necessary to identify specific changes in driving performance that occur after a concussion when compared to a patient's own baseline driving performance.

Our case, although involving only one patient, compared simulated driving ability in an acutely concussed patient to her own baseline simulated driving ability and demonstrated an objective change. We propose that larger-scale studies are needed to investigate the effect of concussion on driving abilities. This is a necessary step to develop clinical guidelines regarding the effects of concussion on driving and expected time to return to baseline driving skill ability. This will ultimately inform recommendations provided to concussed patients by health care providers in an effort to improve the health and safety of the population.

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