

The Game Changer: Keeping Your Head in Contact Sports

By *Patrick R. Field and Kelsey L. Logan*

The Game Changer is an interrupted case study that traces the football career of Anthony “Tony Tonka Truck” Williams and the types of brain trauma that he suffers from playing football, from junior league level through high school, college, and his draft into the pros. To be successful during this case, readers will have to be familiar with the signs, symptoms, epidemiology, and ramifications of concussions, Second Impact Syndrome (SIS), and Chronic Traumatic Encephalopathy (CTE). Students will analyze and compare the differences between these three types of brain trauma and predict the outcome of Anthony’s health based on symptoms and events given in each part. The teaching notes (available online, see Note at end of article) include examples of real cases of young men that have suffered or died as a result of these types of brain trauma.

This case can be completed during one class session and is appropriate for upper level undergraduate and graduate courses in neuroscience, sports-related rehabilitation, physical education, and allied health professions including but not limited to: Sports Medicine, Principles of Neuroscience, Principles of Rehabilitation, Gross Anatomy, and Anatomy and Physiology.

Objectives

Students who successfully complete this case study will be able to:

- discuss the signs and symptoms of concussions, SIS and CTE;
- analyze the implications and the dangerous health that concussions, SIS, and CTE pose;
- apply knowledge of concussions, SIS, and CTE to evaluate a patient’s signs and symptoms, exploring the health hazards of concussions, SIS, and CTE and learning how to avoid these types of injuries in the future.

Classroom management

This interrupted case should be conducted within a single-lecture class period, typically 75–90 minutes. After the instructor gives a short introduction and directions, the class is divided into small groups of four to five students. Each part of the case study should be distributed singularly in sequence. Each of the four parts should take approximately 17–20 minutes for students to complete the assigned tasks: reading each part individually, discussing the case study questions for each part in their small groups, and rejoining the rest of the class for a class discussion of those same case study questions facilitated by the instructor. The real-life examples for each type of brain trauma should be shared with the class. The manner of distribution should be determined by the instructor.

According to the American Orthopedic Society for Sports Medicine Concussion Workshop Group, a concussion is any alteration in

cerebral function caused by a direct or indirect (rotational) force transmitted to the head resulting in one or more of the following acute signs or symptoms: a brief loss of consciousness, lightheadedness, vertigo, cognitive and memory dysfunction, tinnitus, blurred vision, difficulty concentrating, amnesia, headache, nausea, vomiting, photophobia, or a balance disturbance. Delayed signs and symptoms may also include sleep irregularities, fatigue, personality changes, inability to perform usual daily activities, depression, or lethargy. It occurs when the cerebral hemisphere collides with the skull as a result of an impact directly applied to the head causing a “brain bruise,” destruction of capillaries supplying the cerebral cortex.

High school athletes who report three prior concussions are nine times more likely to exhibit three out of the four on-field markers: alteration in mental status/consciousness; loss of consciousness; amnesia; or physical symptoms such as nausea/vomiting, dizziness, balance problems, visual changes, and a presence of posttraumatic headache. Tight ends and defensive linemen in football are most likely to be affected, as they are more susceptible to being tackled and getting hit because they are focusing on tackling others. In football, tacklers and people who are tackled were responsible for 67.6% of concussions; running backs were responsible for 29.4%. Football is the activity that has the most frequently

reported concussive cases, but anyone can get a concussion from a head-related injury.

SIS is defined as rapid cerebral swelling and herniation after a second head injury, in which the location of the second impact is in the exact area of the brain as the initial injury. The patient usually shows symptoms from the first concussion, returns to an activity thinking that everything has healed, and then gets hit so that the brain strikes against the side of the skull in the same place that was damaged in the initial injury.

There can be two different causes of SIS: an injury that results from a direct blow to the head or one from a rotational injury (a blow to neck, chest, or snapping of the head backwards) to a nonskull region of the body that accelerates and moves the brain around, causing the second impact. The effects of the second impact are thought to come from disordered autoregulation of the brain's blood supply.

Within seconds to minutes after the second impact, the player usually collapses to the ground in a semicomatose state and then exhibits grave motor deficits including bilateral pupil dilatation, lack of eye movements, and respiratory failure. Mortality rate (rate of death) is close to 50%. Morbidity (rate of occurring, i.e., if injured in the same place of the brain twice then SIS symptoms occur) is almost 100%.

CTE is a progressive, degenerative brain disorder common in athletes that have a history of blows to the head. It can begin months, years, or even decades after the last brain trauma. It is associated with memory loss, confusion, impaired judgment, impulse control problems, aggression, depression, and eventually dementia. Brain tissue of people found to have CTE display an abnormal build-up of tau proteins that, when leaked into the extracellular environment between neurons, can slow down neural transmission;

lead to neurofibrillary tangles; or disable neural pathways of areas of the brain that control memory, judgment, and fear. Damage to the cerebrum, diencephalon, basal nuclei, brainstem, and cerebellum all result in reduction of brain mass, causing enlargement of the lateral and third ventricles (cavities in the brain that contain cerebrospinal fluid).

The cognitive symptoms are increased irritability, lack of motivation, anger or easier to anger, poor episodic memory, poor executive functioning, depression, paranoia, agitation, social withdrawal, and aggression.

Eighty-seven out of 91 deceased NFL football players that had examinations of their brain postmortem tested positive for CTE. People with CTE tend to commit suicide before the disease claims their life because it is too difficult for them to deal with the implications that the disease causes. Individuals may shoot themselves in the chest to preserve their brain for further research.

Case study

Part I: Youth League: Anthony, Age 12

Massillon, Ohio is known for two things: their history and football. Growing up, if you were a boy and didn't play football, you were considered the outsider. Everyone in the town came out to support the Massillon Tigers on chilly Friday nights at the high school stadium.

As a young boy, Anthony Williams was surrounded by football, from his grandfather, to his father and his friends; he was always around the game. At an early age, Anthony ran faster than the other kids and showed exceptional athleticism, so it was obvious to the town

and to his family that Anthony would play football.

When he reached the age of 6, his parents signed him up in the local youth league with a few of his friends. During the first few years, he played flag football, but when he was 12 years of age, he was able to play tackle for the midgets. Anthony's father, Michael, was the coach for this level. Michael was Anthony's biggest supporter, and he truly believed Anthony had a gift for football. On the other hand, Anthony's mother Samantha was anxious about Anthony's well-being during every game and practice. Samantha supported her husband and son, regardless of her concerns, but she continued to be-

lieve that the game was unsafe.

At the level of youth league football, the players were allowed to play the entire game, including contact play like tackling. This was a different game for a lot of the kids because they were not used to making and taking those kinds of hits, and even though they were small, the force with which they hit could still cause injuries.

During the practices, Michael pushed Anthony to be the best running back he could possibly be. Running backs, after being handed the ball, were expected to run the ball down the field, sometimes through a mob of other players. Anthony played amazingly well throughout

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his first season, even gaining himself the nickname Tony “Tonka Truck” Williams for the way he ran down the field through the other players.

During the last game of the season, Michael played Anthony almost the entire time. After Anthony received the ball at the end of the second quarter, he barreled through the defensive line of the opposing team as usual, but this time, he was severely hit by one of the linemen. Anthony immediately fell to the ground. The game paused, as Anthony was having difficulty standing up.

“C’mon Ant! GET UP!” screamed Michael, as Anthony climbed to his feet. Anthony ran to the sideline, shaking his head. “Are you okay? What happened? Do you feel any pain?” his father asked.

“No, I’m okay. I just have a little headache, but I’ll be okay. I think I’d like to sit out the rest of the game, if that’s okay?” Anthony replied.

Meanwhile, Samantha was very concerned watching from the sideline. She knew it was unlike Anthony to want to sit out the rest of the game.

Questions

1. What could be some physical reasons that Anthony wanted to sit out for the rest of the game? Could there be emotional reasons why Anthony would want to sit out for the rest of the game?
2. What do you think could have physically happened to Anthony that is giving him a headache?
3. Is it something the coaches and his parents should be worried about?

Part II: High School: Anthony, Age 17

Years later, Tony “Tonka Truck” Williams was the star of his high

school football team. He had had an amazing three seasons with the Tigers and was now a senior, scouted by colleges around the country. He had broken the school records for rushing yards and for touchdowns, and it was apparent that the streak would continue in his final year.

Anthony’s high school football coach, Coach Taylor, was Michael’s childhood best friend, as they played together throughout high school. Because of their friendship, Coach Taylor favored Anthony throughout his years in high school, doing his best to make sure Anthony reached his full potential. Because senior year was the most important year to impress scouts and earn a football scholarship to a great school, Coach Taylor, Michael, and Anthony were all working together to highlight his skills and talent. During a cold Friday night game in the middle of the season, Anthony had been playing great throughout the first half, scoring two touchdowns and rushing over 100 yards.

At the beginning of the third quarter, Anthony received the ball and performed his signature move of barreling through the defensive line, but this time he was stopped in his tracks by the largest player on the other team. Anthony was knocked off his feet, and the back of his head hit the ground. He didn’t move for a minute or two. The medical staff rushed onto the field as the players circled around him.

“Anthony, can you hear me? What hurts?” the athletic trainer asked.

“Ugh. My head, it hurts really badly. What happened?”

“You got hit pretty hard. Can you stand up for me?” the trainer asked. Anthony was helped to his feet and stumbled off the field. While be-

ing examined more thoroughly, he complained that he was dizzy and nauseous. Within a few minutes, he began vomiting on the sideline.

“I . . . can’t really . . . see too . . . well. Why are the lights so bright?” Anthony complained. Based on Anthony’s symptoms, the athletic trainer concluded that he should not return to the game until he was cleared by a doctor. Coach Taylor was visibly anxious, as he knew how important the season was to Anthony, but let him sit out anyway.

A week later, Anthony was cleared by the team doctor but was still not feeling 100%. Regardless, he returned to practice because he knew that there would be scouts coming to the next few games, and he knew his dad was anxious for him to play. Samantha was not fond of the idea and confronted Michael. “Michael, he’s our son! He clearly isn’t ready to return to the game! What happens if he gets hit again?” Samantha cried.

“Sam, he’s fine. He’s a tough kid. And besides, don’t you want him to get into LSU? This is what we’ve been talking about since he was a little kid,” Michael calmly responded. Reluctantly, Sam walked away, and Michael took that as the okay to let Anthony continue. Although he was still feeling a little lethargic, Anthony shook it off and prepared for the important upcoming games.

Questions

1. What are the signs and symptoms Anthony displayed after the big hit?
2. What conditions are these symptoms indicative of? What are the possible medical implications?
3. What are the dangers of playing through this type of injury?

4. What would you do if you were in Coach Taylor's position?

Part III: University: Anthony, Age 22

During his high school career, Anthony experienced multiple concussions, none that were extremely serious, but a few that caused him to sit out for a few practices. Nonetheless, his persistence paid off and his talent and skills earned him a full scholarship to his dream school. Anthony had really developed a name for himself, carrying his old nickname Tony "Tonka Truck" Williams.

Michael and Samantha attended every game they could and enjoyed watching their son grow and develop into a football star. Anthony's time in the university's football program had improved his performance, but it had also been detrimental to his health. During a big game against their biggest rival in his sophomore year, breaking his school's records for rushing yards and touchdowns, "Tonka Truck" Williams was hit hard when attempting to make another one of his famous big plays in the third quarter and was knocked to the ground. Unconscious, the medical staff rushed over. After regaining consciousness, Anthony woke up in the locker room with medical staff huddled around him. "What happened?" Anthony asked faintly.

"You tried to run up the middle but were stopped on their 35-yard line. Can you tell me what you are feeling?" the athletic trainer explained and asked.

"I feel lightheaded. And I can't really see straight. But it's okay, this has happened before. All I need is rest and I'll be ready for the next quarter," Anthony insisted.

The athletic trainer responded,

"I'm sorry, but I'm going to have to say no to that. Until you can be cleared by the doctors, I can't let you back onto the field."

Upset and discouraged, Anthony reluctantly agreed after realizing that it was for his own good. After a week and a half of examinations by the team doctor, Anthony finally had a clean CAT scan. Even though he was still feeling a little imbalanced and light-headed, he was cleared and returned for practice. Relieved to see that Anthony was back and feeling better, Coach and the team rushed to get him ready for the upcoming game on Saturday.

During his first play in the game, Anthony, visibly shaking his head in the huddle, continued on with the play. When the play began, Anthony barreled through the line and suddenly fell to his side, landing on his shoulder. Lying unconscious on the ground, the team and medical staff frantically ran over to Anthony. The medical staff quickly checked his eyes, finding that his pupils were bilaterally dilated in the presence of a penlight and were lacking any movement. They called for an ambulance, and he was rushed to the hospital.

At the hospital, Anthony remained in a semi-comatose state for 3 days while undergoing multiple tests and scans on his brain. His parents had been there since the accident, anxious as they wondered what effect this injury would have on their son's health. "Do you see what is happening Michael?! You've been pushing football on him his whole life, making him play no matter how he felt, and look at him now! He's not even conscious. I swear to you, if he doesn't wake up from this, I can't even tell you what is going to happen with us," Samantha cried.

After a week, Anthony woke up. Initially, he had trouble walking and talking, but after working with physical, occupational, and speech therapists, he gradually started to regain his motor and speech abilities. His goal was to return to the field and make his professional dreams a reality.

Questions

1. Describe what physically occurred to Anthony during the initial injury and the second injury.
2. Why did he collapse after the second injury, even though he did not get hit in the head?
3. What conditions are these symptoms indicative of? What are the possible medical implications?
4. What are the risks of playing through this diagnosis?

Part IV: The Pros: Anthony, Age 32

Two years after Anthony suffered SIS on the football field of his university, his dreams of becoming a professional player became a reality; he was picked in the second round of the draft. He played four great seasons, breaking records for rushing yards; Anthony had become a household name.

During the opening game of his fifth season, Anthony was hit hard in the second quarter and collapsed to the ground. Concussions had been a reoccurring injury for Anthony, but the team's neurological consultant as well as the head physician had always properly cleared him before he could play. This time was no different; he was evaluated and cleared to play after 2 weeks of rehabilitation and rest.

Anthony's wife, Tara, had been

with Anthony throughout college and his professional career. In the last few months, she had been noticing some unusual behavior and mannerisms on and off the field. Tara finally confronted Anthony. “Honey, I really think it’s time to think about retiring. You’re so different from when we first started dating. You’re irritable, depressed, you can’t remember our anniversary or where you put your keys, and you’ve become so paranoid! I can’t take seeing you like this. I think it’s time you retire.”

“I think you’re right. But this is my life, I don’t know anything besides me as a football player.”

At the end of the fifth season, Anthony Williams announced a heart-wrenching decision that shocked the sports world: Tony “Tonka Truck” Williams was retiring at the top of his game. The team was upset by the loss of such a great player and person, but his teammates and coaches understood it was the best decision for Anthony’s health. Tony left behind a football legacy, but he was determined to move forward with a healthy life with Tara.

Approximately 6 months after retirement, Tara noticed an increase in Anthony’s aggressive, irritable, and depressive behavior. The slightest thing set him off and made him angry. His memory and paranoia also worsened. He gradually withdrew from social and family gatherings as his depression deepened. Anthony, noting the drastic changes, became concerned; he knew something was not right. He tried to think back to see if any particular incident explained why he was feeling this way, but the only incidents of trauma he could remember were his football injuries.

After 3 years of retirement, feeling withdrawn and angry, Anthony

made the decision that would shock and sadden everyone for years to come. Tara returned home one day to find Anthony dead, a gunshot wound in his chest.

Tara, hysterical, called the police. The police followed protocol and removed him from the house, handing Tara a note the detectives found in his pants pocket. Clearly shaken, she read it:

“Tara, my love, I am sorry for leaving you this way. I have not been myself for a while. It breaks my heart to hurt you like this, but I cannot continue living with these feelings, forgetting everything, being angry constantly, and not being myself. I hope you will forgive me. I love you. Please make sure my brain is studied. Make sure they figure out what is causing my pain, and so many other players’ pain.”

Tara did as she was instructed and had his brain studied. When medical examiners looked at Anthony’s brain, they noticed an unusual amount of tau protein buildup, and there was damage to his cerebrum, basal nuclei, cerebellum, and brain stem. Also, they noticed that there was a decrease in the overall mass of the brain.

Questions

1. What do you think is the root of Anthony’s deterioration?
2. What is his final diagnosis? How did you come to this conclusion?
3. Could anything have been done to prevent Anthony’s suicide or overall diagnosis?

References

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Note: The complete case, along with numerous real-world examples of head injury, teaching notes, and the answer key, may be found at the National Center for Case Study Teaching in Science (http://sciencecases.lib.buffalo.edu/cs/collection/detail.asp?case_id=865&id=865).

Patrick R. Field (pfield@kean.edu) is an associate professor and **Kelsey L. Logan** is a student, both in the Department of Biological Sciences at Kean University in Union, New Jersey.

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