Investigation 3.12

3.12A: Head Injury
3.12B: The Eye

Investigation

3.12A: Head Injury

Introduction:

You have now worked your way through quite a few medical cases using the process of information gathering, formation of a differential diagnosis, and then examining and testing to rule out possibilities until only the correct diagnosis remains. Does the practice of medicine always work that way? It does not. It does not in the same way that you will not make all the decisions you face in your life by considering all the possibilities and logically selecting the best one. Instead, our minds learn **patterns** and **routines** so that we can do complex tasks almost without thinking about them. A piano player first learns to read each note printed in a chord on the sheet of music, but after hours of practice his or her fingers seem to find each key automatically as the musician's eye scans rapidly across the shape of the printed chords.

The experienced healthcare professional similarly learns to see the patterns of many diseases and arrives at a diagnosis almost before finishing taking the history. That ability can enhance productivity, allowing the care provider to help more people. Alternatively, looking for a pattern can lead to mistakes when the mind jumps to a conclusion not completely supported by the facts. We must guard against our instincts, but also must pay attention to cues from our instincts that can sometimes guide us correctly when logic seems to fail. Getting the correct diagnosis every time takes a great deal of care and effort.

In today's case you are providing primary care, not in a hospital, not in an office, but in a gymnasium as part of your civic duty to support the local high school's sports program. You find yourself sitting on the bench of the Brent Hill High School's girls' varsity basketball team. The Cougars are currently undefeated. The bleachers are packed with wildly cheering parents and students, but you have an important job to do not associated with cheering for the home team. You have the responsibility of making sure any injuries during the basketball game receive prompt and proper attention. Playing sports helps young people grow strong bodies and minds, but competitive sports also create a risk of injury. You are saying to yourself, "Please let everyone stay healthy at today's game."

This particular game provides the home team spectators both excitement and frustration. Brent Hill's game plan starts out working well, but the rival team members have a game plan of their own. As the action moves into the final period, Brent Hill misses a few shots and finds itself suddenly six points behind. Alice Harper, a Brent Hill senior, has played hard all game, but as the final minutes tick away she feels a sense of desperation and knows she has to make something good happen. Playing defense, a

careless pass by her opponent puts the basketball suddenly into her hands with no one between her and her team's basket. The fast break race begins. The rival team has two players close on Alice's heels as she races dribbling the ball down the court.

As Alice leaps into the air to release her lay-up, four other outstretched hands reach up, hoping to tip that basketball away from its intended path into the hoop. The ball goes precisely where Alice hoped it would go, but simultaneously three young bodies blend into a single mass of arms and legs, dragged down ruthlessly by **gravity** and propelled forward out of control by **inertia**. As the team physician you miss completely the outcome of the shot because you are focused on those bodies flying through the air. Without even thinking, you find yourself running full speed down the polished basketball court with the full knowledge that the result of that much **kinetic energy** hitting the floor has to have unintended consequences.

You, plus two very experienced Brent Hill Paramedics whom you know well as Liz and Graham, arrive at the awkwardly entangled pile of girls splayed on the gymnasium floor. You cannot see much of Alice because the two girls who chased her down the court fell on top of her. You also do not see any **blood**, and you rejoice momentarily in that finding. Liz kneels at one side of the heap and Graham has gotten down on all fours at the other side to help untangle the players and begin to sort out any injuries. The two rival players are moving, cautiously, slowly, and groaning as they free themselves from the entanglement.

Paramedics receive extensive training in managing victims of trauma, so Liz and Graham have gone immediately into a practiced mode of trying to identify serious injuries quickly while not allowing the injured to do things that might make their situation worse. They caution the players not to move until they know more about their injuries.

At the same time your mind has focused on Alice because you know she hit the floor first with the combined inertia of three players, not one. She appeared at first to be shaking underneath the two other players. As Liz and Graham carefully help the top two players move away from Alice, you see that Alice's right leg has a distinct bend, not in a place normal legs bend. Alice is resting face down on the floor, no longer shaking, but not trying to get up. You look closer and are relieved to see respiratory movements. You bend down and call her name. No response.

Graham tells you that the two rival players appear to have no major injuries, and he suggests that he and Liz grab some supplies from their ambulance unit to stabilize that obviously broken leg prior to transporting Alice to the hospital.

As you learned previously, you are thinking circulation, airway, and breathing. What do you do to evaluate circulation and airway? (We noted respiratory movement already.)

1. _____

You were happy to see that she fell with one arm elevated to protect her head from hitting the floor directly. There is no blood on her or the floor. No fractures of other bones are obvious. You see lots of good signs to suggest Alice did not receive any horrible injuries. What remains for you to consider in evaluating Alice?

1. _____
2. _____
3. _____

If you are having trouble with that answer, why not take a history from Alice starting with her chief complaint. Oops. Alice is not responding to you!

Meanwhile Liz and Graham continue to apply their training and are recording Alice's vital signs. **Respiration** 28/minute. **Blood Pressure** 190/88. **Pulse** 140. You can see Alice's face and you lift her eyelids to examine her pupils. You see big **pupils** and almost no **iris** at all.

You turn to Liz and Graham and say, "Graham you support her legs, and I'll carry her upper body. Liz we are going to the hospital right now! Call ahead and tell them we have a closed head injury with a presumed **intracranial bleed** and need a **neurosurgeon** now."

Time for some physiology and an explanation: Of all the marvels of the human body, the human **brain** ranks right at the top. **Neurophysiologist**s, the scientists who study this organ, know a great deal about how it works but still have vast numbers of unanswered questions. You may be aware that trauma to the brain, especially from playing football, has received much debate in the media. Sports coaches increasingly sideline players who hit their heads for several weeks before allowing them to return to play. A blow to the head can bruise one or more areas of the brain with minimal symptoms, but without time to fully recover from that injury the brain has decreased **tolerance** to another injury.

The human body protects the brain by surrounding it with bone, the **skull**. In addition the brain floats in a watery fluid called **cerebral spinal fluid** inside the skull as an extra protective cushion against **mechanical** injury. But the skull actually creates the potential for a type of injury you may not know about. Neurosurgeons (often referred to in slang as brain surgeons) will tell you that while they deal with many urgent problems in their practice, they only have one condition they deem a true emergency (a problem they need to treat without any delay). An **intracranial arterial bleed** constitutes that single emergency in neurosurgery. If an artery is bleeding inside the skull, the skull bone confines that blood so that the pressure inside the skull climbs to the pressure in the artery. Normally the **veins** inside the skull would drain away the blood so the

pressure would not rise, but when an artery has broken open that no longer happens as the blood leaves its normal path from arteries flowing into veins.

If the pressure inside the skull grows to match the arterial blood pressure, the flow of blood and oxygen to the brain comes to a halt and brain cells cannot survive very long in that condition. In this case presentation we have distracted you, Liz, and Graham with an obviously broken leg, but we wanted you to recognize that Alice was not moving or talking, so the real emergency did not come from a broken leg, but from an injury to the head. We had you look at the pupils that were abnormally dilated, and that finding signaled that the brain no longer was sending signals to the eyes. We put words in your mouth to declare Alice's condition a life-threatening emergency that required immediate action in a hospital from a neurosurgeon.

The idea of performing surgery on either the heart or the brain appears to have come to medicine relatively recently. History calls Dr. Harvey **Cushing** the Father of Modern Neurosurgery for his creation of methods to treat the brain surgically beginning about the time of the First World War (early 1900s). Having said that, a procedure called **trephination** dates back to around 6500 BCE and appears to represent one of the earliest forms of surgery. Trephination means cutting a hole into the skull, not actually surgery on the brain but an important procedure for our injured basketball-player. Alice needs an emergency life-saving trephination to relieve the high pressure inside her skull so that normal blood flow to her brain can resume. A modern neurosurgeon does this very carefully with specially designed tools in order to relieve that pressure safely under **sterile** conditions (to avoid any infection). In addition, a modern **neurosurgeon** would next find the site of bleeding (surgery on the brain itself) and treat that as well.

Why might Alice's fall have caused a bleed inside her head while the other players did not have similar serious injury? Alice might have hit her head on the floor with enough force to actually **fracture** her skull to produce that injury, but our view of the event actually suggested that did not happen. She actually appeared to protect her head with her hand as she fell. This may have been consistent with a **concussion**, but her injury symptoms went beyond a concussion. Alice suffered a more severe injury because she had a **cerebral aneurysm**, a weak or thin area in the wall a blood vessel in the brain that occurs in about 1 in every 10,000 people. As a result she was more likely than others to have that vessel break open inside her skull without warning.

Rapid diagnosis of this event, along with the prompt action you, Liz, and Graham took to get Alice to a neurosurgeon quickly, saved her life.

Case Review:

This case represents a departure from our normal process of collecting information and moving methodically to a diagnosis and then treatment. Instead we have a case of an emergency in which medical training made it possible to make quick evaluations and move right to life-saving treatment. Some fields of medicine commonly put providers in emergency situations, while others rarely involve the need to make quick decisions and

take prompt action. **Rate the specialties below** by drawing a circle **with regard to the frequency of emergencies you would expect them to encounter:**

Frequency of Emergencies			**Medical Specialty**
Rare	Occasional	Common	CARDIOLOGIST
Rare	Occasional	Common	DERMATOLOGIST
Rare	Occasional	Common	EMERGENCY ROOM PHYSICIAN
Rare	Occasional	Common	OBSTETRICIAN
Rare	Occasional	Common	PATHOLOGIST
Rare	Occasional	Common	PODIATRIST
Rare	Occasional	Common	ANESTHESIOLOGIST
Rare	Occasional	Common	ORTHOPEDIST
Rare	Occasional	Common	OPTHAMOLOGIST
Rare	Occasional	Common	TRAUMA SURGEON

Take a moment to think about your own personality and ask yourself if you think you would find a career that presented you with desperate emergencies energizing or exhausting. Careers that deal with emergencies exist in many forms not always associated with medicine, for example policemen and firemen; people who elect to fill those careers provide services of great value to society as a whole. Your perspective on this issue can easily change as you grow and have new experiences. Do not make any lasting decisions; just consider your current feelings, briefly, today.

Alice experienced a severe injury because she had a condition that made that injury more likely. She did not cause that condition or even know she had an **aneurysm**. That hardly seems fair, and yet such things exist in the world. In many ways medical science represents a desire to restore some fairness to nature, by allowing people who have injury or disease, through no fault of their own, to have their health restored. The desire to make the world fairer for every person can serve as a reason to elect a career in healthcare.

Take a moment to jot down anything you want to remember about your feelings regarding Alice's injury and the role of those who worked hard to restore her to a normal life.

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Vital Signs Review:

Blood Pressure

Systolic Blood Pressure: Normal resting systolic pressure in a young adult is below 120 mmHg.

Diastolic Blood Pressure: Normal resting diastolic pressure in a young adult is below 80 mmHg

Strenuous activity can increase both systolic and diastolic blood pressure.

Heart Rate

Normal resting heart rate is between 60 and 100 beats per minutes. Trained athletes are usually at the lower end of the spectrum.

Respirations

Normal resting respiratory rate is between 12 and 20 breaths per minute.

Strenuous activity can raise the respiratory rate.