Timothy Bowman, DOB 03/07/2004

Presentation

Timothy Bowman, a 13-year-old boy, was small for his age. He was in the 25th percentile in height and the 20th percentile for his weight. In addition to his small size, Timothy began to express abnormal behavior when compared to other children. According to his mother, Karen, Timothy was constantly tired and irritable. Whenever Karen asked him to do something for her, he complained that he did not have the energy. He complained about persistent abdominal pains, which Karen attributed to his poor appetite. Many nights he wouldn't even finish his favorite meal macaroni with meatballs.

One day Karen got a call from Timothy's teacher who was concerned about Timothy's recent academic behavior. He had failed to turn in multiple assignments, and when asked why he did not complete them, he answered that he had forgotten. This was concerning for Karen given that Timothy had always been a good student. Karen never had to be the type of parent to check in on her son constantly throughout the evening to ensure he was doing his homework. Timothy's teacher continued to inform Karen that her son seemed distracted in class, and had stopped interacting with many of his peers. Now Karen was starting to worry.

When Karen went to pick Timothy up from his afterschool program that afternoon, Karen found Timothy in a corner all by himself hunched over with his arms cradling his stomach. When she walked over to him, Timothy looked up at her with his eyes glazed over.

"I don't feel so good…" He said to his mother, who knew immediately that something was very wrong. Karen quickly gathered together Timothy's things and drove straight from the school to the ED.

History

Family medical history: Timothy's maternal and paternal grandmothers had breast cancer, and Timothy's paternal grandfather had high cholesterol.

Personal medical history: Timothy had his tonsils taken out when he was two years old due to sleep apnea. He also has had a concussion.

Progression

Dr. Jones met Timothy and his mother in the ED and proceeded to examine Timothy. The nurse took Timothy's vitals. Dr. Jones asked Karen to fill him in on what had happened. Troubled by Timothy's recent behavioral changes, Dr. Jones ordered a series of blood tests.

Initial Vitals

BP: 127/84 mmHg
Respirations: 10 breaths per minute
HR: 52 BPM
Temperature: 97.9 °F

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SpO2: 98 %
Lung sounds: clear and equal bilaterally

Blood/Urine

Red Blood Cell (RBC) Count: 5.07 x 10^6/uL *(normal: 4.50-5.30 x 10^6/uL)*
White Blood Cell (WBC) Count: 8.90 x 10^3/uL *(normal: 4.50-13.0 x 10^3/uL)*
Platelet Count: 3.07 x 10^5/uL *(normal: 1.50-4.50 x 10^5/uL)*
Albumin: 4.07 g/dL *(normal: 3.2-4.5 g/dL)*
Total Serum Proteins: 4.87 g/dL *(normal: 3.8-5.4 g/dL)*
Erythrocyte Protoporphyrin (EP) Level: 42 ug/dL
Blood Lead Level (BLL): 82 ug/dL
Hematocrit: 48% *(normal: 36-51%)*
Hemoglobin: 15.2 g/dL *(normal: 13.0-16.0 g/dL)*
Serum Calcium: 9.3 mg/dL *(normal: 8.0-11.0 mg/dL)*
Serum Potassium: 4.1 mmol/L *(normal: 3.4-4.7 mmol/L)*
Blood Urea Nitrogen (BUN): 12 mg/dL *(normal: 5-18 mg/dL)*
Creatinine: 0.53 mg/dL *(normal: 0.3-0.7 mg/dL)*
Serum Ferritin: 97 ug/L *(normal: 7-140 ug/L)*
Thyroid-Stimulating Hormone (TSH): 2.3 ulU/mL *(normal: 0.7-64.0 ulU/mL)*
Thyroxine (T_4): 6.2 g/dL *(normal: 5.6-11.7 g/dL)*
Toxicology Screening: Negative

Imaging

Timothy Bowman, DOB 03/07/2004

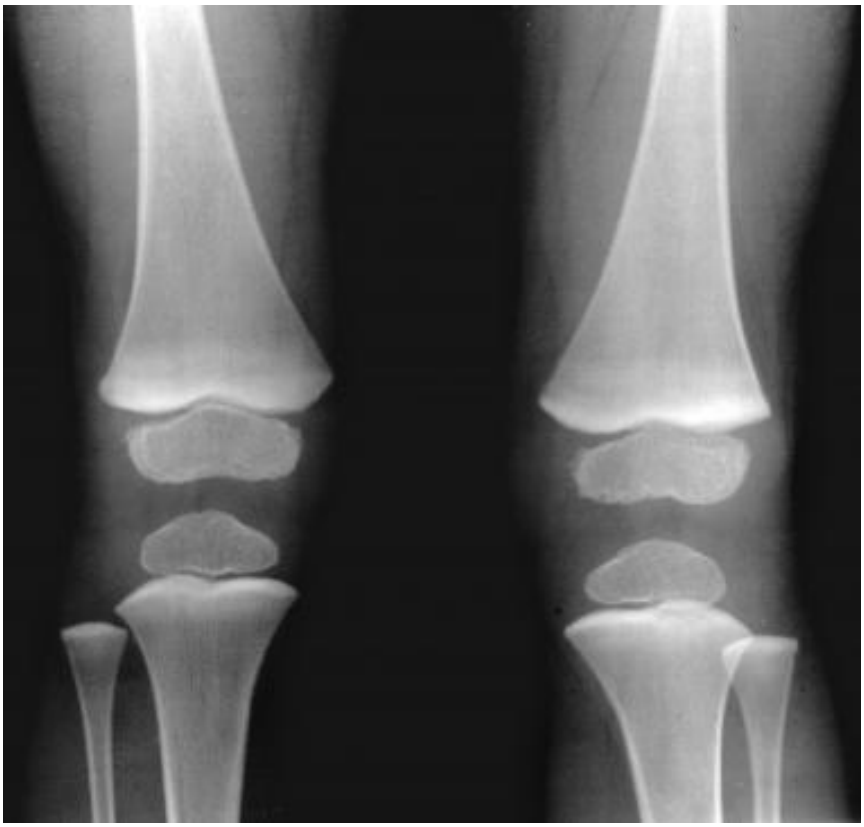
Timothy Bowman; DOB: 03/07/2004; Medical Record #133407

Abdominal Plain Film

Timothy Bowman, DOB 03/07/2004

Timothy Bowman; DOB: 03/07/2004; Medical Record #133407

Echocardiogram



Timothy Bowman; DOB: 03/07/2004; Medical Record #133407

X-Ray Image – Dense Metaphyseal Bands

Timothy Bowman, DOB 03/07/2004

Differential Diagnosis

- Hydrocarbon Inhalation Injury
- Anemia
- Iron-deficiency Anemia
- Lead Poisoning
- Growth Failure
- Constipation
- Failure to Thrive
- Anorexia

Diagnosis

Although several differential diagnoses could fit Timothy's condition, Dr. Jones knew that he could pin point exactly what was wrong based on Timothy's examination and test results. Dr. Jones began by considering anorexia. After discussing Timothy's eating habits and mental health he was certain anorexia was not the underlying cause of Timothy's condition.

Because of Timothy's complaints of abdominal pain, Dr. Jones wondered whether constipation could be the problem. However, viewing Timothy's normal abdominal plain film quickly ruled out this possibility.

Failure to thrive, an interruption of the normal growth pattern, was another consideration, given Timothy's small size and weight. He was able to rule this out after viewing Timothy's normal albumin, total protein, and electrolyte levels.

Next, Dr. Jones considered anemia. However, Timothy's RBC, WBC, and platelet counts were all normal, as were his hemoglobin and hematocrit levels. In addition, Timothy's ferritin levels were also normal. These factors ruled out both anemia and iron-deficiency anemia.

Hydrocarbon inhalation injury was another possible explanation for Timothy's symptoms. This condition results from accidental or inappropriate (i.e. for recreational use) inhalation of hydrocarbons. In order to rule out hydrocarbon inhalation injury, Dr. Jones needed to look at Timothy's serum calcium and potassium levels. These levels were normal. He also looked at Timothy's toxicology screening, because if Timothy were to use hydrocarbon inhalants for recreational use, it is possible that he was also using other drugs. This test was negative. Timothy's echocardiogram was also normal. All of these factors caused Dr. Jones to move away from hydrocarbon inhalation injury as Timothy's diagnosis.

Finally, Dr. Jones considered lead poisoning. Timothy's symptoms of stunted growth, abdominal pains, fatigue, irritability, memory loss, and lack of focus match well with this diagnosis. Timothy's severely elevated blood lead levels and higher-than-normal EP level allowed Dr. Jones to confirm lead poisoning as Timothy's diagnosis. His X-ray also reveals dense metaphyseal bands, which are often present in children with lead poisoning, as are hypertension, bradycardia, and a slow respiratory rate.

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Treatment

Because Timothy's blood lead level is higher than 70 ug/dL, it is considered a medical emergency, and therefore he would be admitted to the pediatric ICU where he will undergo intense chelation therapy. Chelation means to grab. The treatment involves binding to heavy metals to pull them out of the blood stream in order to reduce the effect that they have on the body. Calcium ethylene diamine tetra-acetic acid (EDTA) will likely be administered intravenously over the course of five days, but it could also be administered by intramuscular injection.

Dimercaprol, also known as British anti-Lewisite (BAL) will likely also be administered as a secondary treatment in order to ensure that lead contained within the blood-brain barrier is also eliminated. Calcium EDTA is unable to cross this barrier while dimercaprol can. This treatment is generally administered between two and five times a day by intramuscular injection over the course of two to ten days.

It is important to note that these treatments are very toxic to the body, especially to the liver and the kidneys. Therefore, rest periods are often needed between rounds of treatment.

Eliminating lead exposure is crucial for treating chronic lead poisoning. If lead pipelines are still present in town or the home infrastructure, water that is clean at the distribution site could become contaminated while traveling from the distribution site to the home. Lead paint, could also be the source of lead exposure. Even second-hand smoke inhalation can serve as a source of lead exposure. It is crucial to eliminate exposure in order for Timothy to fully recover.

Disease Background

Lead poisoning is a condition that is caused by absorption of lead into the body. Lead can enter the body via ingestion, inhalation, or absorption through the skin. Gastrointestinal lead absorption often causes abdominal pain. Once lead has entered the body, indicated by high blood lead levels, it can interfere with enzyme function, specifically enzymes involved in reducing oxidative stress, or the buildup of free radicals. In the presence of lead, the number of free radicals present in the cell increases because the cell loses its ability to combat these harmful radicals. A key antioxidant enzyme involved in this detoxifying process is glutathione (GSH). Lead binds to key sulfhydryl groups located within the enzyme, thereby inactivating them. Lead can also replace important metal enzyme cofactors, also inactivating enzymes. Enzyme inactivation can induce cell stress and in some cases even cell death. Inactivation of ferrochelatase causes an increase in EP levels. Lead deposits in the brain and central nervous system can cause fatigue, irritability, memory loss, and lack of focus. Deposits in the bone can cause stunted growth.

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