NATIONAL CENTER FOR CASE STUDY TEACHING IN SCIENCE

Drug Wars: An Epic Tale of Asthma and Bacterial Pneumonia



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Episode I – The Phantom Asthma Menace

Day 1 (Saturday 10 a.m.)

Ten-year-old Leia was taken to the on-call pediatric clinic that collaborates with her pediatrician's office after a rough night of little sleep with severe wheezing and a frequent, dry cough. During the night, her mother had given Leia albuterol and fluticasone approximately every four hours using an inhaler-spacer delivery method when Leia's coughing was so bad her sleep was disturbed. This was the pediatrician's recommended treatment for when asthma symptoms appeared. Leia had had a runny nose for a few days before the coughing began on Friday evening but no fever.

When Dr. Skywalker saw Leia at the clinic, her mother told him the wheezing and cough began rather suddenly on Friday evening but Leia had no fever, sore throat, head ache, chest pain, or vomiting. She told the doctor that Leia had a history of asthma since the age of five when she was hospitalized with bacterial pneumonia about the time the family moved to New England from France. Leia was up-to-date on all other routine childhood vaccinations except for the pneumococcal vaccine, which Leia had never received. While in France, she had received the BCG vaccine as it was required in France for entry into preschool. Leia's asthma appeared to be triggered only by viral respiratory infections. She did not appear to have any other triggers for asthma, including participation in sports.

Dr. Skywalker noted that Leia's oxygen levels were in the slightly low-normal range. After an albuterol nebulizer treatment, her lungs sounded clear and she was sent home. The doctor recommended continuing both albuterol and fluticasone every four to six hours. Leia continued to improve dramatically over the course of that day and she got lots of rest over the weekend. Leia's mother reduced the albuterol to longer intervals and Leia went to school on Monday, energetic and happy, though she still had a mild residual cough.

Questions

1. List five common environmental triggers for asthma and give at least one specific example for each.
2. Describe the impact of asthma (e.g., morbidity, mortality, economic impact, groups disproportionately affected) on the U.S. population.
3. What is the mechanism of action of albuterol? What is the mechanism of action of fluticasone? Which one is commonly used to treat serious asthma symptoms? Which one is typically used to prevent serious asthma symptoms?

References

MedlinePlus.
Asthma in Children: http://www.nlm.nih.gov/medlineplus/asthmainchildren.html
Albuterol: http://www.nlm.nih.gov/medlineplus/druginfo/meds/a682145.html
Fluticasone: http://www.nlm.nih.gov/medlineplus/druginfo/meds/a601056.html

Centers for Disease Control and Prevention (CDC).
Asthma Fact Sheet from the CDC: http://www.cdc.gov/asthma/impacts_nation/asthmafactsheet.pdf

Episode II – Revenge of the 'Roids

Day 14 (Friday)

Leia started to experience asthma symptoms again. While she was not short of breath, she had a severe, dry, barking cough. Her mother took her to see her pediatrician, Dr. Amidala. Dr. Amidala wasn't available however, and so Leia saw another pediatrician, Dr. Vader, who diagnosed severe asthma but not pneumonia. After taking Leia's age, weight, and other factors into consideration, Dr. Vader prescribed the oral steroid prednisone. On Saturday, Leia complained about the steroid medication. She told her mother she didn't like how it made her feel. On Sunday, Leia had a severe behavioral disturbance that was very uncharacteristic of her. She broke down over a very small problem and even became physically violent. She said the medicine made her feel "frustrated." Because of Leia's strong reaction to the drug, her mother checked the prescription instructions to make sure she was giving Leia the right dose.

Questions

4. How is prednisone different from fluticasone? Is there more of a risk of side effects with prednisone? Why or why not?
5. Could the behavioral problems that Leia experienced be the result of the oral steroid? Briefly describe any evidence for this, including how dosage might factor into the incidence of side effects.
6. Besides Leia's mother possibly giving the wrong dose to Leia, what other types of mistakes could cause Leia to get too much of this medication?

References

Steroid Medication

MedlinePlus.
Prednisone: http://www.nlm.nih.gov/medlineplus/druginfo/meds/a601102.html

Schuh, S. et al. (2000). A comparison of inhaled fluticasone and oral prednisone for children with severe acute asthma. *N Engl J Med*, 343(10), 689–94.

Neuropsychiatric Side Effects

Kayani, S., & Shannon, D.C. (2002). Adverse behavioral effects of treatment for acute exacerbation of asthma in children: a comparison of two doses of oral steroids. *Chest*, 122(2), 624–8.

Dawson, K.L. & Carter, E.R. (1998). A steroid-induced acute psychosis in a child with asthma. *Pediatric Pulmonology*, 26, 362–4.

West, S., & Kenedi, C. (2014). Strategies to prevent the neuropsychiatric side-effects of corticosteroids: a case report and review of the literature. *Curr Opin Organ Transplant*, 19(2), 201–8.

Medication Errors

Davis, T. (2011). Paediatric prescribing errors. *Arch Dis Child*, 96(5), 489–91.

Academy of Managed Care Pharmacy.
Medication Errors Fact Sheet: http://amcp.org/WorkArea/DownloadAsset.aspx?id=9300

Lesar, T.S. (2002). Prescribing errors involving medication dosage forms. *J Gen Intern Med*, 17(8), 579–587.

Wong, I.C., Wong, L.Y., & Cranswick, N.E. (2009). Minimising medication errors in children. *Arch Dis Child*, 94(2), 161–4.

Episode III – Attack of the Bacterial Clones

Day 17 (Monday a.m.)

Due to the behavioral incident on Sunday, Leia's mother had brought her back to the pediatric drop-in clinic where she was seen by the nurse practitioner, Ms. Yoda. There appeared to be the sound of a fluid infiltrate in the lower right quadrant of Leia's lung. Ms. Yoda diagnosed pneumonia and prescribed amoxicillin (a penicillin derivative). No other diagnostic testing was done. Note that Leia had not exhibited a high or sudden fever at any point during the last few weeks and she had gone to school regularly although she continued to have a mild cough.

Questions

7. What type(s) of bacterial pathogens commonly cause community acquired pneumonia in the U.S.? Make sure to include the full genus and species names, including the name for the pathogen that causes "walking pneumonia."
8. Which of these pathogens should we worry the most about in Leia's particular circumstance? Explain your answer.
9. Which of the vaccines in the recommended childhood vaccination schedule will protect against pneumonia? Include vaccines that protect against viral and bacterial causes of pneumonia.
10. What is the mechanism of action of amoxicillin? What types of common bacterial causes of pneumonia will it work against? What types of common bacterial causes of pneumonia will it not be effective against?
11. None of the healthcare providers so far have ordered a diagnostic test to screen for the type of pathogen (chest X-ray, etc.). Why do you think this is?
12. What problem(s) should we be concerned with when prescribing an antibiotic that may not actually be effective for the type of pathogen that a person is infected with?

References

Centers for Disease Control and Prevention (CDC).
Pneumonia: http://www.cdc.gov/pneumonia/
Atypical Pneumonia: http://www.cdc.gov/pneumonia/atypical/
Immunization Schedules: http://www.cdc.gov/vaccines/schedules/easy-to-read/index.html

Todar's Online Textbook of Bacteriology.
http://textbookofbacteriology.net

MedlinePlus.
Amoxicillin Fact Sheet: http://www.nlm.nih.gov/medlineplus/druginfo/meds/a685001.html

Schauner, S., Erickson, C., Fadare, K. & Stephens, K. (2013). Community-acquired pneumonia in children: A look at the IDSA guidelines. *The Journal of Family Practice*, 62(1), 9–15.

Episode IV – A New Antibacterial Hope

Day 17 (Monday p.m.)

Leia's mother was a microbiologist. Based on the symptoms that Leia had experienced from the beginning of the illness, she was concerned that her daughter has been prescribed amoxicillin instead of azithromycin (a derivative of erythromycin). She called Dr. Kenobi, the chief pediatrician at the practice, to inquire about the rationale behind giving Leia amoxicillin instead of azithromycin.

Questions

13. Why does Leia's mother think that azithromycin should be prescribed?
14. Despite Leia's mild symptoms (lack of fever, no shortness of breath), describe at least two things in Leia's medical history that might warrant treatment against the more serious pathogens that amoxicillin targets?

References

MedlinePlus.
Azithromycin: http://www.nlm.nih.gov/medlineplus/druginfo/meds/a697037.html
Erythromycin: http://www.nlm.nih.gov/medlineplus/druginfo/meds/a682381.html

Epilogue

Days 18–25

Leia improved gradually. However, the antibiotic regimen gave her stomach pain and diarrhea, which resolved with the probiotics recommended by Dr. Kenobi. During the four years following her epic adventures with asthma, steroids, antibiotics, and probiotics, Leia has not had any further asthma symptoms or pneumonia episodes.

Questions

15. What will probiotics do for Leia?
16. What are your thoughts on the number of different health care providers that Leia has seen (including the fact that she was never able to see her actual pediatrician Dr. Amidala)? What are some of the advantages associated with better "continuity of care"?
17. What are some of the best methods for managing childhood asthma?

References

American Academy of Family Physicians.
Continuity of Care: http://www.aafp.org/about/policies/all/definition-care.html

Haggerty, J.L. et al. (2003). Continuity of care: a multidisciplinary review. *BMJ*, 327, 1219–1221.

Christakis, D.A. et al. (2001). Association of Lower Continuity of Care With Greater Risk of Emergency Department Use and Hospitalization in Children. *Pediatrics*, 107(3), 524 –529.

Infectious Diseases Society of America. Infections by Organ System. Community-Acquired Pneumonia (CAP): http://www.idsociety.org/Organ_System/#CommunityAcquiredPneumoniaCAP

American Academy of Pediatrics.
Many resources available, including Pediatric Care Online: https://www.pediatriccareonline.org/
(Search for "asthma")

Merck Childhood Asthma Network.
Changing pO$_2$licy: The Elements for Improving Childhood Asthma Outcomes.
http://www.mcanonline.org/static/images/files_ChangingpO2licyReport.pdf

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