Web Case Study

Kimberley Roberts

Wright State University

Web Case Study

Focused History and Physical

Source

Patient, reliable source

Chief Complaint

Cough, shortness of breath, fever, chills and weakness all over

History of Present Illness

This patient is a 24 year old male who presents to the Emergency Department (ED) with complaints of a non-productive cough and dyspnea that started approximately a week ago. Fever, chills and myalgia started this morning prompting his ED visit. He has dyspnea at rest that worsens with exertion. He admits to having midsternal chest pain only while coughing. He denies syncope, palpitations, and swollen extremities. He states he has lost five pounds over the last couple of days. He denies nausea, vomiting, and diarrhea. Reports to have a decreased appetite for one week. His past medical/surgical history consists of focal segmental glomerulosclerosis (FSGS), chronic renal failure (CRF), and a kidney transplant six months ago. His current medications are; triple drug immunosuppression, (tacrolimus, prednisone, and mycophenolate mofetil) and tylenol as needed for fever. He does not smoke or use illicit drugs. He occasionally drinks socially. Electrocardiogram (ECG) reveals sinus tachycardia at 115bpm with no Q waves or ST changes. Chest x-ray (CXR) shows patchy alveolar infiltrates along with bilateral small pleural effusions. The advanced practice nurse (APN) ordered a chest computerized tomography (CT), labs, blood and fungal cultures. The ED staff notified the transplant team of patient's arrival.

Medical History

FSGS, and CRF

Surgical History

Living- donor kidney transplant in July 2012

Family History

Mother has diabetes and hypertension. Father has hypothyroidism, hypertension and depression. Maternal grandmother died from pneumonia. Patient is unsure about other relative history.

Social History

Patient lives alone in an apartment in Norwood, OH. He works in construction and returned back to work three months ago, but has been off sick for the last three days. He is unsure of any specific chemical or environmental job exposures. He purchases his own medical insurance as his employer does not provide this. His parents are divorced and live several hours away. He does not see them often. His older brother provides him with social support when he is in town. He enjoys hiking with his dog on his free time. He denies smoking and any recreational drug use. He drinks alcohol occasionally, but denies use since his kidney transplant. He denies recent travel, and cultural or religious needs. He states he has not been sexually active for the last six months and denies being in a relationship.

Allergies

Penicillin - rash

Medications

Tacrolimus 4mg po daily

Prednisone 10mg po daily

Micophenolate mofetil 1000mg po twice a day

Review of Systems

General: Reports fatigue, weakness, and chills. Lost 5lbs over the last week. Febrile. Height 5'9", current weight 124lbs, BMI 18.3

Neurological: Denies any mental status or memory changes. Denies headache, dizziness, numbness and tingling.

HEENT: Denies visual changes, eye pain, eye drainage, ear pain, ear drainage, hearing loss, nasal congestion, runny nose, mouth/throat sores, and mouth/throat pain.

Neck: Denies noting any swollen glands.

Respiratory: Complains of a non-productive cough and dyspnea at rest which worsens with exertion. Denies wheezing.

CV: Complains of midsternal chest pain with coughing. Denies palpitations, and swelling of extremities.

GI: Denies nausea, vomiting, indigestion, difficulty swallowing, diarrhea, constipation, and dark or bloody stools.

GU: Denies frequent urination, hesitancy, pain, urgency, odorous urine, bladder and prostate problems, and impotence.

M/S: Complains of general weakness. Denies muscle and joint pain.

Skin: Denies any rash, nevi changes, and skin lesions

Psychosocial: Complains of loneliness and feeling overwhelmed at times. States he has been anxious about his difficulty to breathe. Complains of coughing and dyspnea keeping him awake. Denies hallucinations and delusions.

Physical Exam

General: Alert, anxious, diaphoretic, cooperative, well groomed sitting forward with hands tightly gripping hospital bed rails.

Vital Signs: Temperature 102.2 ˚ F orally, HR 115 bpm, BP 82/50, RR 28bpm, SPO2 88 % on room air

Neurological: Alert and oriented to person, place, time and situation. Anxious. Follows commands. GCS – 4/5/6. Cranial nerves II-XII intact.

HEENT: The skull is normocephalic, atraumatic, no masses or lesions palpated. Sclera white, conjunctiva pink. Pupils 4mm constricting to 2mm, equally round and reactive to light and accommodations (PERRL), extraocular muscles intact, no nystagmus, no hemorrhages or exudates noted. Tympanic membranes pearly grey bilaterally without bulging or fluid, good cone of light. Nasal mucosa moist and pink, septum midline; no sinus tenderness. No exudate. Throat without lesions, erythema or exudate. Oral mucosa pink & moist without erythema. Good dentition.

Neck: Trachea midline. Neck supple; thyroid isthmus palpable. No cervical or axillary adenopathy. No tenderness palpated

CV: No jugular vein distention and edema. Carotid upstrokes are brisk, without bruits. The PMI is located in the 5th interspace 7cm lateral to the midsternal line. S1 and S2 normal without S3 or S4. At the apex S1 is heard louder than S2 with no extra heart sounds or murmurs. Apical pulse rhythm regular and tachycardic. No heaves or thrills palpated.

Respiratory: Thorax is symmetric with good expansion and mild use of intercostal muscles.

Breath sounds clear and diminished in the bases; no rhonchi, rales or wheezes. Dull percussion over bilateral lower lobes posteriorly, resonant in all other lobes. Decreased tactile fremitus over bilateral lower lobes; no bronchophony, egophony, or whispered pectoriloquy.

Abdomen: Active bowel sounds in all four quadrants. Soft, non-distended, and non-tender abdomen; no hepatosplenomegaly, or palpable masses. No liver and CVA tenderness.

M/S: Strength 5/5 in all extremities, full range of motion in all joints, 2 + reflexes and symmetric.

Skin: Color pink. Skin hot and diaphoretic. Decreased turgor. No rashes, ecchymoses, pressure ulcers, or suspicious nevi. Nails without cyanosis.

Laboratory Findings

Fungal cultures are gold standard testing for histoplasmosis. Culture results may take up to one month and can reveal false negatives (Hage & Wheat, 2012). Results should not delay initial treatment in the critically ill patient. Tuberculosis skin test negative.

Table 1. Complete Blood Count and Renal Panel

Complete Blood Count (CBC)	**Results**	**Normal Values**	**Renal Panel**	**Results**	**Normal Values**
WBC	2.1K cells/mL	3.8-10.8K cells/mL	Sodium	143 mmol/L	135-146 mmol/L
RBC	2.68M cells/mL	3.80-5.10M cells/mL	Potassium	3.8 mmol/L	3.5-5.3 mmol/L
Hemoglobin	8.8 g/dL	11.7-15.5 g/dL	Chloride	110 mmol/L	98-110 mmol/L

Hematocrit	26.3%	35.0-45.0%	Carbon dioxide	27 mmol/L	21-23 mmol/L
MCV	98.2 fL	80.0-100.0 fL	BUN	27 mg/dL	7-25 mg/dL
MCH	32.7 pg/cell	27.0-33.0 pg/cell	Creatinine	1.5 mg/dL	0.50-1.20 mg/dL
MCHC	33.3 g/dL	32.0-36.0 g/dL	Glucose	176 mg/dL	65-99 mg/dL
RDW	15.3%	11.0-15.0%	Calcium	8.5 mg/dL	8.6-10.2 mg/dL
Platelet	90 K/uL	140-400 K/uL	Phosphorus	2.8 mg/dL	2.5-4.5 mg/dL
MPV	8 fL	7.5-11.5 fL	Magnesium	2.3 mg/dL	1.5-2.5 mg/dL
Neutrophils Relative	75%	40.0-80.0%	Albumin	2.1 g/dL	3.6-5.1 g/dL
Bands Relative	11%	0.0-9.0%	Total protein	4.2 g/dL	3.6-5.1 g/dL
Lymphocytes Relative	9%	15.0-45.0%			
Monocytes Relative	1%	0.0-12.0%			
Eosinophils Relative	4%	0.0-8.0%			
n RBC	1	0.0/100WBC			
Neutrophils Absolute	12600 uL	1500-7800/uL			
Absolute Lymphocytes	1512 uL	850-3900/uL			
Monocytes Absolute	168 uL	200-950/uL			
Eosinophils	672 uL	15-1500/uL			

Absolute					
Bands Absolute	1848 uL	0-750/uL			

Table 2. Arterial Blood Gas and Other Laboratory Findings

Arterial Blood Gas (ABG)	**Results**	**Normal Values**	**Other Laboratory Findings**	**Results**	**Normal Values**
% HBO2	93.1%	95.0-98.0%	Alkaline Phosphatase	68 U/L	33-130 U/L
pH	7.40	7.35-7.45	Lactate dehydrogenase	287 U/L	205.3-474.5 U/L
pCO2	45mmHg	35-45mmHg	Ferritin	850 ng/mL	9-300 ng/ml
pO2	66mmHg	80-100mmHg	ESR	8 mm/hr	< 15 mm/hr
HCO3	28 mmol/L	22-26 mmol/L	Urine Histoplasma Antigen	29.52 ng/ml	
CO2 content	29 mmol/L	23-27 mmol/L	CRP	2 mg/dL	< 1.0mg/dL
Base Excess	-3.0	-2.0-3.0	Lactic acid	1.7 mmol/L	0.5-2.2 mmol/L
Carboxyhemoglobin	1	Unknown	Pre-albumin	7.2 mg/dL	17.6-36.0 mg/dL
Methoglobin	0.7%	0.0-1.5%	Transferrin	< 80 mg/dL	206-381 mg/dL
Reduced hemoglobin	5.2%	0.0-5.0%	Serum triglycerides	217 mg/dL	10-150 mg/dL

Diagnostic Findings

ECG showed sinus tachycardia. CXR showed patchy alveolar infiltrates and bilateral small pleural effusions. Chest CT scan revealed ground glass opacities and small pleural effusions in bilateral lower lobes. Preliminary reports from bronchioalveolar lavage (BAL) fluid culture showed histoplasma yeasts. BAL culture specificity is approximately 75% for histoplasmosis (Hage & Wheat, 2012). Fungal and blood cultures have no growth to date.

Differential Diagnosis

Differential diagnoses include community acquired pneumonia, tuberculosis (TB), blastomycosis, post-transplant lymphoproliferative disease (PTLD), Epstein Barr (EBV), and cytomegaly virus (CMV) (Proia, 2003). Immunocomprimised individuals are extremely high risk for getting opportunistic infections. Infectious processes pose life-threatening complications among this population. Symptomology alone is insufficient to completely rule out these differentials. Therefore, laboratory and diagnostic findings are indicators of the true diagnosis and rule out differentials.

Another consideration with determining diagnoses are the origin of potential organisms. Bird and bat droppings mixed with soil increases spores and growth of histoplasma capsulatum. This occurs largely in Ohio and Mississippi River valleys where the climate and humidity enhance growth. This area has been branded as an endemic for histoplasmosis (Wheat et al., 2007). Therefore, living and working as a construction worker in this area combined with immunosuppressive therapy places this patient at an extraordinary high risk for contracting this illness. One must take into consideration environmental factors when considering a diagnosis with every patient.

Acute pulmonary histoplasmosis is the likely diagnosis for this patient. The highly positive urine histoplasma antigen, positive BAL culture, and symptomology described and

observed from the patient point to this diagnosis. Immunosuppression combined with inhalation of this organism led to susceptibility and vulnerability (Wheat et al., 2007).

Plan

Clinical guidelines for management of histoplasmosis are continually evolving with new clinical studies revealing best practice. According to Infectious Diseases Society of America (IDSA), specific antifungals are used in combination with other medications depending on the type of histoplasmosis (Wheat et al., 2007). Acute pulmonary histoplasmosis and immunosuppression requires immediate treatment to prevent further disease progression. Treatment with amphotericin B and methylprednisolone intravenously (IV) are indicated based on severity of infection. The medical history and stability of the patient must be considered to determine the formulation of amphotericin B prior to initiation of therapy. The deoxycholate formulation of amphotericin B is nephrotoxic and studies have shown increased creatinine levels in healthy individuals (Barrett et al., 2003). Avoiding this preparation for this patient lowers the risk of renal injury.

This patient will be started on a lipid formulation of Amphotericin B (3.0-5.0 mg/kg) daily IV for 1-2 weeks followed by itraconazole 200mg three times daily for three days and then 200mg twice daily for a total of 12 weeks as recommended. Most recent guidelines recommend treatment combined with methylprednisolone (0.5-1.0 mg/kg) daily IV during the first 1-2 weeks of antifungal therapy for respiratory compromised individuals (Wheat et al., 2007).

Additional therapy would include; resuscitation efforts for dehydration, patient education, and supportive care (Lo, Dixon, & Czech, 2010). Increasing oral intake and starting intravenous fluids are indicated based on laboratory findings (base excess, lactic acid, and creatinine). Hypokalemia may result from drug therapy, thus discussion of eating potassium enriched foods

and ordering supplements may be necessary (Lexicomp, 2013). Nutritional education and supplements are also needed based on patient's albumin and pre-albumin levels. Possible discussion of enteral support with this patient may follow depending on course of treatment. Supplemental oxygen will be started at 2L/nasal cannula initially and titrated to maintain SP02 greater than 90%. Further monitoring of labs is indicated.

Drug Therapy

Drug and Cost	**Drug to Drug Interactions**	**Adverse Effects/Precautions**	**Follow Up Monitoring**	**APN May Prescribe**
Amphotericin B deoxycholate generic $76.00 per dose Amphotericin B lipid complex (Abelcet) $740.00 per dose Liposomal amphotericin B (AmBisome) $1099.00 per dose Amphotericin B cholesteryl sulfate complex (Amphotec) $360.00 per dose	Other nephrotoxic agents; aminoglycosides (Gentamycin), Cyclosporine, Tacrolimus, Arsenic Trioxide	Nephrotoxicity more pronounced in deoxycholate formation, cardiac toxicity and myopathy, liver toxicity more pronounced in lipid formations, hypokalemia, hypomagnesaemia, weight loss, malaise, anemia, thrombocytopenia, mild leukopenia. Infusion related reactions; fever, chills, nausea, vomiting, headache, hypotension, tachypnea. Severe chest, back and abdominal pain with initial infusion of AmBisome. Precautions: be sure to know exactly what formulation is being prescribed to ensure accurate dosing, failure to do	Monitor CBC, Renal panel, hepatic function tests, and urine histoplasma antigen regularly. Monitor pulmonary function. Monitor vital signs every 30 minutes for 4 hours after initial IV test dose. Patient education: instructing patient to report signs and symptoms of dysrhythmias, hypotension, thrombocytopenia, anemia and nephrotoxicity	May prescribe if physician initiates or physician is consulted. Must be stated in standard care arrangement.

		so can result in fatal cardiac arrest. Avoid concomitant corticosteroids, ACTH, nephrotoxic agents. Should be avoided with renal impairment.		
Itraconazole Capsules (Generic) 100mg (30 day supply): $251.98 Sporonox (Brand) 100mg (30 day supply): $439.99 Solution 10mg/ml (150ml): $217.99	Abiraterone Acetate, Aliskiren, Amiodorone, Aprepitant, Atorvastatin, Avanafil, Axitinib, Bosutinib, Brentuximab, Bretylium, Bromocriptine, Cabazitaxel, Cabozantinib, Cervastatin, Citalopram, Clozapine, Cobicistat, Crizotinib, Cyclosporine, Dasatinib, Diazepam, Digoxin, Disopyramide, Docetaxel, Domperidone, Efavirenz, Elvitegravir, Enzalutamide, Erythoromycin, Etravirine, Everolimus, Fentanyl,	Adverse effects: Anaphylaxis, abdominal pain, nausea, vomiting, diarrhea, pruritis, edema, dizziness, liver toxicity, Stevens-Johnson syndrome, toxic epidermal necrolysis, pancreatitis, pulmonary edema, congestive heart failure Precautions: use of oral solution is not recommended in severe neutropenic patients, discontinue if neuropathy occurs, do not use if hypersensitive to other azole medications, discontinue if hepatotoxicity occurs, contraindicated in hepatic failure, should not be used with other CYP3A4	Urine histoplasma antigen to monitor improvement of fungal infection, hepatic function tests, monitor for signs and symptoms of hepatotoxicity Patient education: report symptoms of Stevens-Johnson syndrome (flu-like symptoms, spreading of red rash, blisters on skin or mucous membranes, report symptoms of liver toxicity, and congestive heart failure. Instruct patient	May prescribe if physician initiates or physician is consulted. Must be stated in standard care arrangement

	Fluticasone, Halofantrine, Ibutilide, Ifosfamide, Iloperidone, Isoniazid, Ivacaftor, Ixabepilone, Lapatinib, Lenallidomide, Mifepristone, Nevirapine, Nilotinib, Oxycodone, Pazopanib, Regoralinide, Rifabutin, Rifampin, Rivaroxaban, Romdepsin, Ruxolitnib, Salmeterol, Sirolimus, Sotalol, Sunitinib, Tacrolimus, Tadalafil, Tamsulosin, Temsirolimus, Ticagrelor, Toremifene, Vemurafenib, Venlafaxine, Vinblastine, Vincristine, Vincristine Sulfate Liposome, Vinorelbine, Warfarin	inducers or medications metabolized by this, contraindicated in concomitant use with drugs utilizing gastrointestinal absorption as it increases plasma levels of drug	to take capsules at the same time each day with meals to ensure maximal absorption. If taking oral solution, instruct to take on an empty stomach. If missed dose, instruct patient to skip dose and take at next scheduled time.	
Methylprednisolone 40mg vial: $12.99	Acetylcholinesterase Inhibitors, Aldesleukin, Aminoglutethimid,Amphotericin B, Antacids,	Adverse effects: adrenal suppression, anaphylaxis, dermal changes, immunosuppression with prolonged use,	During treatment monitor: blood pressure, blood glucose, and electrolytes.	CTP holder may prescribe

	Antidiabetic agents, Antifungal agents, Aprepitant, Aripiprazole, Barbituates, Bile Acid Sequestrants, Calcitrol, Calcium channel blockers, Carbamazepine, Coccidiodin skin test, Corticorelin, Cyclosporin, CYP3A4 inhibitors,Deferasirox, Denosumab, Echinacea, Estrogen derivatives, Fluconozole, Fosaprepitant, Fosphenytoin, Hyalurondiase, Indacaterol, Isoniazid, Leflunomide, Lomitapide, Loop diuretics, Macrolide antibiotics, Mifepristone, Mitotane, Natalizumab, Neuromuscular-blocking agents, NSAIDS, Phenytoin, Pimecrolims, Pimozide, Primidone,	myopathy, kaposi's sarcoma with prolonged treatment, psychiatric disturbances, osteoporosis with long term use, renal impairment, thyroid disease, arrhythmias, bradycardia, cardiac arrest, CHF, edema, fat embolism, HTN, syncope, tachycardia, delirium, depression, emotional instability, euphoria, hallucinations, headache, increased ICP, insomnia, malaise, mood swings, nervousness, neuritis, personality changes, dry scaly skin, ecchymoses, edema, erythema, impaired wound healing, petechiae, rash, skin atrophy, urticaria, hyperglycemia, glucose intolerance, hyperlipidemia, hypokalemia, hypokalemic alkalosis, sodium and water retention, abdominal distention, increased appetite, gastrointestinal hemorrhage/perforation, nausea, vomiting, peptic ulcer, pancreatitis.	Patient education: report increased pain, excessive or sudden weight gain; swelling of extremities; muscle pain or weakness; vision changes; signs of hyperglycemia; signs of infection; blackened stool; or worsening condition.	

	Quinolone, Rifamycin derivatives, Roflumilast, Salicylates, Sipuleucel, Tacrolimus, Telaprevir, Thiazide diuretics, Tofacitinib, Trastuzumab, Vaccines, Warfarin	Contraindications: Hypersensitivity to methylprednisolone; systemic fungal infection; and administration of live virus vaccines		

Drug information retrieved from the Medical Letter, 2012; Lexicomp, 2013

Advanced Practice Nurse (APN) Authority to Prescribe

In the state of Ohio, APNs who hold a current certificate to prescribe (CTP) may prescribe amphotericin B (all formulations) IV and itraconazole PO with physician collaboration or initiation. Physician collaboration denotes that the APN must directly discuss the patient with the collaborating physician before starting treatment and documenting this consultation. Physician initiation implies the patient is examined by the collaborating physician prior to prescribing the treatment. The APN with a CTP can prescribe the initial treatment after either option is completed. The APN can then modify and end treatment prescribed without additional consultation. Methylprednisolone may be prescribed by the APN. The standard care arrangement must note specifics of collaboration with prescribing medications (Ohio Board of Nursing, 2013).

Clinical Study

Although clinical guidelines indicate amphotericin B for treatment of histoplasmosis, there are limited randomized control trials on amphotericin B. Most of the evidence supporting management came from cohort studies, case reports, non-randomized control trials and case

series (Wheat et al., 2007). Treatment guidelines don't specifically address treatment in the solid organ transplant (SOT) population. A retrospective case analysis was conducted during 1997-2007 including SOT patients'. The case analysis reported the incidence of histoplasmosis and treatment used among SOT patients'. Several methods were used to collect data: positive histoplasma capsulatum microbiology test results from SOT patients; data extrapolated from SOT database reporting all opportunistic infections and outcomes; and all histoplasma positive donor lung transplants and recipient's tissue. Inclusion criteria involved all types of SOT patients (kidney, liver, lung, pancreas, and heart) and diagnosis of histoplasmosis based on more than symptomology alone. During the study period, 29 patients among the 3572 SOT performed met inclusion criteria and 14 confirmed to have histoplasmosis (Cuellar-Rodriguez et al., 2009).

Investigators evaluated the incidence, treatment, and patient outcomes. Most frequent immunosuppressive therapy among this study population was tacrolimus, mycophenolate mofetil and prednisone (64%) (Cuellar-Rodriguez et al., 2009). The majority of patients diagnosed resided in Ohio. Data discovered both disseminated and localized histoplasmosis among this population. Pancreas transplants had the highest incidence of histoplasmosis (26.3 cases). Total incidence for post-transplantation histoplasmosis was 1 case per 1000 person years. Treatment included amphotericin, itraconazole, and corticosteroids for those with severe respiratory involvement. Amphotericin was among the most commonly used medication for this group studied with a 23.5 day average course of treatment. After two weeks of therapy, nine of eleven patients treated with amphotericin B switched to itraconazole and the remaining two took voriconazole. The average follow up was 19 months from initial diagnosis. Antifungal treatment was stopped in seven of 14 patients who were cured, six patients remained on antifungal

medications, and one patient had a reoccurrence after three months of discontinued treatment (Cuellar-Rodriguez et al., 2009).

Legal and ethical issues are important to consider when conducting a study. In this study, two patients were given voriconozole for treatment of histoplasmosis based on physician preference. No current studies suggest voriconazole as first line treatment. Lack of evidence supports this decision. Treatment guidelines state fluconazole may be given in patients intolerant to itraconazole. Voriconazole has been used in a small number of AIDS patients who were resistant to both medications; however this was not cited as the reason. All other azole medications are considered second line therapy because of limited evidence based practice studies (Wheat et al., 2007). Legal actions may be taken if severe adverse reactions occur when deterring from the treatment guidelines with no supported evidence. Informed consent, IRB approval, anonymity and security of data were not reported. This leads to concern for confidentiality and privacy of patient information. Without mention of this in the study, it is hard to determine whether this was actually performed prior to initiation of research.

Limitations of this study include small sample size and lack of control trials to support treatment regimens. Although initial population of SOT is large, only a small portion of these patients were found to have active histoplasmosis. This small sample size led to wide confidence intervals decreasing clinical significance and replication of data. The lack of control trials hinders the efficacy of treatment among the population studied. However, treatment was determined to be effective in this study. Regardless of the small sample size and lack of control trials, this study showed benefits using amphotericin B and itraconazole for pulmonary histoplasmosis based on improved clinical patient outcomes.

Issues

Several considerations prior to determining the plan of care for this patient are necessary. With the patient's recent history of a kidney transplant, treatment with lipid formulation amphotericin B is essential to decrease his risk for nephrotoxicity. Again, evidence has shown marked increases in creatinine levels and acute tubular necrosis with deoxycholate formulations of amphotericin B (Barrett et al., 2003). Although the lipid formulations are significantly more expensive, the benefits outweigh the risks for this patient.

Another important factor to consider when prescribing medications is drug to drug interactions. Currently the patient is taking tacrolimus as a part of his immunosuppression therapy to prevent transplant rejection. Drug to drug interactions can occur with amphotericin B and tacrolimus; itraconazole and tacrolimus; methylprednisolone and amphotericin B and methylprednisolone and tacrolimus. Amphotericin B combined with tacrolimus can increase tacrolimus plasma levels. Itraconazole is a CYP450 3A4 enzyme inhibitor and has the potential of interacting with other medications (Cuellar-Rodriguez et al., 2009; Wheat et al., 2007). Itraconazole may increase tacrolimus levels thus the need to closely monitor levels and adjust appropriately. Food and antacids can decrease the bioavailability of the drug depending on the preparation of itraconazole. If prescribing the capsule form, educate patient to take with food. The opposite is true with the oral solution, which is instructed to take on an empty stomach preferably two hours before meals (Wheat et al., 2007). Methylprednisolone can interact with tacrolimus and amphotericin B causing hypokalemia and increased tacrolimus plasma levels. Close monitoring of electrolytes and tacrolimus levels are essential with treatment. Careful consideration is necessary before prescribing any medication.

Incorporating education on how to decrease his risk is important to prevent reoccurrence of contracting another opportunistic infection. Discussing change in regards to his occupation

and or other avenues for financial support could prove beneficial. Sensitivity is essential when exploring this issue.

Legal and Ethical Considerations

Ethical considerations are fundamental prior to implementing a treatment plan. The principle of non-maleficence is upheld with prescribing the lipid formulation amphotericin B, preventing damage of the transplanted kidney. Justice can be applied when considering cost of medications and prescribing cheaper alternatives. Unfortunately, the lipid formulations of amphotericin B are expensive and the risk of using deoxycholate formation could be detrimental to this patient's newly transplanted kidney.

Legally, maintaining confidentiality and privacy of detailed information obtained from the patient is important and will build rapport. Knowing and understanding the Ohio Revised code and Administrative code are essential prior to initiating a treatment plan. Failure to provide sufficient follow-up, monitoring, and recognizing contraindications can result in legal action if adverse events occur as a result of treatment (Lawriter, 2012).

Discussion Questions

1.) What considerations should be taken in regards to continued immunosuppressive therapy with this patient? Explain your rationale for continuing or discontinuing this treatment and whether APN's are allowed to prescribe immunosuppressive agents.

2.) Explain how to determine effectiveness of antifungal treatment and what follow up is necessary upon completion?

References

Barrett, J., Vardulaki, K., Conlon, C., Cooke, J., Daza-Ramirez, P., Evans, G., ... Viscoli, C. (2003, March 9). A systematic review of the antifungal effectiveness and tolerability of amphotericin B formulations. *Clinical Therapeutics*, *25*, 1295-1320. doi: 10.1016/S0149-2918(03)80125-X

Cuellar-Rodriguez, J., Lard, A., Budev, M., Gordon, S., Shrestha, N., Van Duin, D., ... Mawhorter, S. (2009, July 27). Histoplasmosis in solid organ transplant recipients: 10 years of experience at a large transplant center in an endemic area. *Clinical Infectious Diseases*, *49*, 710-716. http://dx.doi.org/10.1086/604712

Hage, C., & Wheat, L. (2012). Histoplasmosis. In D. Longo, A. Fauci, D. Kasper, S. Hauser, & J. Loscalzo (Eds.), *Harrison's principles of internal medicine* (18 ed.). Retrieved from http://www.accessmedicine.com.ezproxy.libraries.wright.edu:2048/content.aspx?aID=9110624

Lawriter. (2012). *Administrative rules for prescribing drugs and therapeutic devices* (Report no. 4723.50). Retrieved from Ohio laws and rules: http://codes.ohio.gov/orc/4723.50

LexiComp. (2013). Retrieved from http://webstore.lexi.comPDA-software-for –nurses

Lo, M., Dixon, B., & Czech, K. (2010). Disseminated histoplasmosis associated with hemophagocytic lymphohistiocytosis in kidney transplant recipients. *American Journal of Transplantation*, *10*, 687-691. http://dx.doi.org/10.1111/j.1600-6143.2009.02969.x

Ohio Board of Nursing (2013). The formulary developed by the Committee on Prescriptive Governance. Retrieved from http://www.nursing.ohio.gov/PDFS/ AdvPractice/1-20-13_Formulary.pdf

Proia, L. (2003). Fungal pneumonias. In M. Hanley, & C. Welsh (Eds.), *Current diagnosis and treatment in pulmonary medicine*. Retrieved from http://www.accessmedicine.com.ezprozy.libraries.wright.edu:2048/content.aspx?aID=578406

The Medical Letter (2012). Treatment guidelines: Antifungals. *The Medical Letter Inc.* August 1, 2012. Issue 120. Retrieved from http://secure.medicalletter.org.ezproxy.libraries.wright.edu:2048/TG-article-120a

Wheat, J., Freifeld, A., Kleiman, M., Baddley, J., McKinsey, D., Loyd, J., & Kauffman, C. (2007). Clinical practice guidelines for the management of patients with histoplasmosis: 2007 update by the infectious diseases society of America. *Clinical Infectious Diseases, 45*, 807-825. doi: 10.1086/521259