Care of the AIDS Patient With *Pneumocystis* Pneumonia

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Pneumocystis pneumonia and AIDS have been linked together for many years. In the 1980s and1990s, these diseases often resulted in admission to the critical care unit for many patients. Since the discovery of antiretroviral therapy and Pneumocystis prophylaxis, this has been a less frequent occurrence. Knowledge about caring for this patient in the critical care unit is often not available. Psychological and physiological needs common to this population are different from other populations and must be addressed. Pharmacological challenges are common and may go unrecognized until complications ensue. This article seeks to alleviate some of the mystery associated with these issues.

Keywords: AIDS, HIV, Pneumocystis, Pneumonia

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Pneumocystis pneumonia (PCP) and human immunodeficiency virus (HIV) have been linked together since the first cases of AIDS were discovered in the early 1980s.[1,2] The death of gay men from PCP with no history of an immunodeficient disorder sparked the controversy that introduced the United States and, subsequently, the world to the virus that ultimately has caused the death of millions. Today, even with the introduction of antiretroviral therapy, PCP remains the most common opportunistic infection in persons with AIDS and oftentimes is the diagnostic red flag that alerts healthcare providers to the possibility of HIV disease and AIDS.[3]

Although PCP occurs in patients immunosuppressed from other diseases, it is most known for its prevalence in patients with HIV/AIDS,[4] and unfortunately, it is the most frequently occurring opportunistic infection in the untreated and undiagnosed patient with HIV/AIDS. Early in the history of the disease, the usual cause of admission to critical care units for patients with AIDS was respiratory failure secondary to *Pneumocystis* pneumonia.[5] Today, in those infected with HIV, other illnesses account for admission to critical care units, but PCP stills ranks first as the most common serious opportunistic infection.[6]

Today, respiratory failure in persons with HIV/AIDS continues to dominate the cause for admission to critical care units, but less often because of *Pneumocystis* pneumonia.[7] Such respiratory illnesses as bacterial pneumonia, tuberculosis, asthma, and emphysema can lead to respiratory complications with immune reconstitution inflammatory syndrome secondary to the first 2 diseases also being a possibility. Typically, patients who are admitted secondary to PCP have either not received treatment with antiretroviral therapy and/or prophylactic PCP medications or not responded to these.[2]

PATHOPHYSIOLOGY

Pneumonia secondary to *Pneumocystis jiroveci* has long been noted to cause physiological problems in individuals with HIV infection. *Pneumocystis jiroveci* was once referred to as *Pneumocystis carinii* because of confusion

regarding the colonization in the mammalian species.[8] *Pneumocystis carinii* is the name designated for infection in rats with *jiroveci* denoting infection in humans. The acronym PCP used in the past to designate pneumocystic *carinii* pneumonia now reflects ***P**neumocystis* **p**neumonia.

The transmission of *Pneumocystis* pneumonia in humans is still unclear.[8] Although initially it was believed to be acquired during childhood and remain dormant until a time of immunosuppression in adulthood, this theory has not been totally supported. Airborne transmission is noted in animal species and now is thought to be the likely culprit in human transmission. The *Pneumocystis* pneumonia that infects rats cannot be transmitted to humans, nor the human form transmitted to rats.[9]

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Pneumocystis has a unique attraction for the lung where it adheres to the epithelium of the alveoli.[9] This activates an inflammatory response in the lungs that results in diffuse alveolar damage, impaired gas exchange, and possible respiratory failure. The inflammatory process is magnified by the appearance of greater numbers of neutrophils and CD8 T cells in the lungs, which increases hypoxemia and mortality associated with PCP in persons with AIDS.[10] Further complicating the process is the impaired function of macrophages found in patients with AIDS. This impairment results in a decreased clearance of *Pneumocystis*.[9] With extensive lung inflammation and an altered inflammatory response, the risk of respiratory impairment is amplified, and death more likely. Also of concern are the increased incidence of pneumatoceles in patients with PCP and AIDS and the subsequent risk of pneumothorax, which adds to the severity of the illness.[11] Often added to these factors is the lack of history of an immunosuppressive disorder, which results in a delayed diagnosis. All of these contribute to make PCP a life-threatening illness that may result in admission to the critical care unit.

CLINICAL PRESENTATION

Individuals with HIV/AIDS who are infected with PCP present with a variety of symptoms, although some may be asymptomatic.[4] The insidious onset begins with a dry cough and exertional dyspnea in the weeks prior to the development of other symptoms.[3,4] A fever plus headache, malaise, night sweats, general fatigue, weight loss, and chest pain are among the clinical manifestations reported. Tachycardia and tachypnea also may be present. Lung sounds typically reveal no abnormalities.

Patients with severe PCP may develop hypoxemic respiratory failure and present with symptoms similar to acute respiratory distress syndrome such as hypoxemia, intrapulmonary shunting, and decreased pulmonary compliance.[2] Progression of the disease results in a further decrease of pulmonary compliance and possible development of a pneumothorax. Unfortunately, symptoms of this nature signal a poor prognosis. Radiographic features may include diffuse opacities, but a chest radiograph revealing no abnormalities is possible. In this case, high-resolution computer tomography is recommended to evaluate the presence of extensive ground-glass attenuation or cystic lesions.[9] Interstitial infiltrates found by computer tomography may exhibit a central, peripheral, or mosaic distribution.[4] Less often linear opacities, cavitary lesions, nodules, and pneumothoraces are seen.

Definitive diagnosis of PCP is made when organisms are found in specimens obtained through sputum induced by inhalation of hypertonic saline or bronchoscopy. A lung biopsy can be used but usually is not needed.[9] Some clinicians choose to treat patients with PCP symptoms without bronchoscopy unless response to therapy is limited. Rosen and Narasimhan[2] suggest that similar outcomes are realized with both treatments.

Although an elevated serum lactate dehydrogenase level has been found in patients with PCP, it is thought to be secondary to lung inflammation and injury rather than the disease itself.[9] Because this diagnostic finding is associated with other illnesses that reflect an inflammatory response, dependence on it to diagnose PCP is not advised.

Infrequently *Pneumocystis* pneumonia can occur in extrapulmonary sites such as the lymph nodes, spleen, liver, bone marrow, gastrointestinal tract, eyes, ears, kidneys, thyroid, and adrenal glands.[3] Although it may occur in only one of these, it usually is present in multiple places. Clinical manifestations, which include abdominal pain, hepatitis, anasarca, dysphagia, and chest pain, are based on the sites affected.

MEDICAL MANAGEMENT

Prophylaxis for PCP is begun in patients with HIV/AIDS when their CD4 count falls below 200 cells/μL or they develop oral candidiasis.[4,9,12] Prophylaxis continues until the CD4 count increases to more than 200 for 3 months, but should it drop again, prophylaxis is restarted. Prophylaxis consists of trimethoprim-sulfamethoxazole (TMP-SMX) for those who have not had any past reactions to the drugs. Those who cannot tolerate these or who do not respond to TMP-SMX have several other options as listed in Table 1.[2,9,12]

TABLE 1 ***Pneumocystis* Pneumonia Prophylaxis and Treatment[2,9,12]**

Medications With Dosages	Duration
Prophylaxis	
TMP-SMX 1 DS PO QD	Until CD4 count >200 cells/μL
TMP-SMX 1 SS PO QD	Until CD4 count >200 cells/μL
TMP-SMX 1 DS PO 3 times/wk	
Dapsone 100 mg PO QD or 50 mg PO QD *or*	Until CD4 count >200 cells/μL
Dapsone 50 mg PO QD	Until CD4 count >200 cells/μL
Pyrimethamine 50 mg PO/wk	
Leucovorin 25 mg PO/wk	
Dapsone 200 mg PO/wk	Until CD4 count >200 cells/μL
Pyrimethamine 75 mg PO/wk	
Leucovorin 25 mg PO/wk	
Aerosolized pentamidine 300 mg via nebulizer every month	Until CD4 count >200 cells/μL
Atovaquone 1,500 mg PO QD with food	Until CD4 count >200 cells/μL
Treatment	
Mild to moderate PCP[a]	
TMP 15-20 mg/kg per day	PO or IV for 21 d in 3-4 divided doses or 14 d if mild disease and rapid response
SMX 75-100 mg/kg per day	
TMP 15 mg/kg per day PO	21 d
Dapsone 100 mg/d PO	
Clindamycin 600-900 IV q6h-q8h	21 d
Primaquine 15-30 mg/d base PO	
Clindamycin 300-450 mg PO q6h	21 d
Primaquine 15-30 mg/d base PO	
Atovaquone 750-mg suspension PO BID with meals	21 d
Severe PCP[a]	
Pentamidine 3-4 mg/kg per day IV	21 d

Abbreviations: BID, twice a day; DS, double strength; IV, intravenous; PO, oral; q6h, every 6 hours; q8h, every 8 hours; QD, every day; SS, single strength; TMP-SMX, trimethoprim-sulfamethoxazole.

[a]Add prednisone 40 mg PO BID × 5 days followed by 40 mg PO × 5 days and 20 mg PO QD for a total of 21 days *or* methylprednisolone IV at 75% of prednisone doses.

The drugs of choice for severe PCP are the same as those used for prophylaxis. A combination of trimethoprim and sulfamethoxazole 15 to 20 mg/kg for the former and 75 to 100 mg/kg for the latter is given daily in divided doses for 21 days. For those patients who are allergic to sulfa, other drugs as listed in Table 1 may be used.[9] Corticosteroids also are of value when HIV-infected patients with *Pneumocystis* pneumonia have hypoxemia (room air Po_2 <70 mm Hg or an arterial-alveolar oxygen difference of >35 mm Hg).[2,9,13] The recommended dose is prednisone 40 mg twice daily for 5 days with a decreasing regimen followed for a total of 21 days.[13,14]

Prior to administering TMP-SMX, dapsone and primaquine, the patient should also be evaluated for glucose-6-phosphate dehydrogenase deficiency.[12] Glucose-6-phosphate dehydrogenase deficiency predisposes people to hemolytic anemia when taking these medications.

Patients with severe PCP are admitted to critical care units for multiple reasons. Some are there to undergo bronchoscopy or observation after complications from that procedure, mask application of continuous positive airway pressure, or close observation not available on a typical hospital floor.[2] Others require supportive treatment for severe PCP including intubation, mechanical ventilation, and application of positive end-expiratory pressure because of acute respiratory failure.

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NURSING MANAGEMENT BY CRITICAL CARE NURSES

Admission to a critical care unit is a stressful occurrence in an individual's life. The surroundings are not like anything most people have ever seen and subject them to situations they are ill equipped to handle. The addition of respiratory compromise further insults their sensibilities and promises to introduce them to a level of fear and stress most people have never imagined. According to Perrin,[15] critically ill patients consider the greatest sources of stress to be discomfort, decreased communication, increased anxiety, and sleeplessness. In recognizing these, the nurse can work to create an environment in which patients can be as comfortable as possible as they heal.

Discomfort for a patient with PCP can come from several areas. The most life-threatening issue is the respiratory compromise. The critical care nurse should begin with a thorough respiratory assessment including the patient's opinion regarding his/her level of breathing difficulty.[16] A graphic rating scale that rates difficulty on a scale of 1 to 5, with one being no difficulty and 5 being extreme difficulty, is one method, and a visual analog scale that allows the patient to chart the difficulty on a

vertical or horizontal line that is anchored by descriptors is another. The nurse should keep in mind the patient's reading ability and any language difficulties when administering either of these.

Also of importance is any history of respiratory illnesses. Has the patient had any respiratory illness including PCP in the past that required oxygen and/or intubation? Has mechanical ventilation been necessary with any illness? These questions will assist the nurse in evaluating the patient's present knowledge regarding pulmonary illnesses and treatment modalities. They will also enable him/her to prepare the patient for any future treatments that may be necessary.

Determining which physical position most assists the patient in breathing is helpful. Although nurses may assume that the higher the level of the chest, the greater the ease of breathing, it is best to consult the patient prior to positioning him/her in any way. Some prefer semi-Fowler position, whereas others request a higher elevation with multiple pillows. The patient may need assistance in reaching this position because of extreme dyspnea.

In the process of collecting the above subjective data, the critical care nurse simultaneously obtains objective data such as the patient's general appearance, color, respiratory rate, rhythm, and amplitude. Also, the presence of symmetrical chest movements and any use of accessory muscles and nasal flaring should be evaluated. After determining the above data, careful auscultation of the lungs is required, noting any abnormal or absent breath sounds. Pulse oximetry, arterial blood gases, and chest radiographs should be evaluated. All of these data will assist the nurse in making the patient as comfortable as possible.

Another source of discomfort could be pain. Evaluate the patient's pain level by requesting he/she rate the pain on a scale of 1 to 10, with 10 being the most severe. Also ask the patient to identify the site of the pain, intensity, radiation, associated symptoms, and any known means of alleviation. Pain in patients with HIV/AIDS can have multiple origins, so a careful assessment is necessary. The presence of an undiagnosed or diagnosed HIV-related illness could be the culprit. Seeking the assistance of a healthcare practitioner versed in the care of such patients is invaluable.

The patient's anxiety level will be elevated as a result of the admission to the critical care unit and dyspnea. If the patient has just been diagnosed with HIV/AIDS, there will be added anxiety associated with disclosure, stigmatization, and fear of impending death. The nurse should begin his/her association as he/she would with any patient. A brief introduction is appropriate followed by an explanation of the unit set-up and routine procedures. The patient should be assured that every effort will be made to alleviate any respiratory difficulties and to ensure he/she is comfortable. At some point, the nurse needs to determine if friends and family members are present and who is aware of the diagnosis. After this is ascertained, the nurse should assure the patient that his/her confidentiality will be protected.

The patient may or may not be experiencing decreased communication, depending on the patient's responsiveness and/or presence of mechanical ventilation. If the patient is sedated, the nurse may have to repeat information several times. If the patient is on a ventilator, the nurse should make greater efforts to communicate. Research indicates that sedated patients remember the communication of nurses.[15] Critical care nurses recognize the importance of communication but in meeting the patient's needs often overlook it. Even though it appears 1-sided, the words are comforting to the patient.

Should the patient be responsive and nonsedated or lightly sedated, communication may be difficult and tiring.[15] A calm, kind approach is helpful. If the patient is ventilated, investigate the use of a letter board. Oftentimes, head nodding and hand gestures are used. Some nurses become quite adept at reading lips, although it can be frustrating to both the patient and the nurse. Whatever means of communication is established, make certain to explain any treatment prior to beginning, and ensure that the patient is prepared. Any healthcare provider should ask the patient's permission prior to touching the patient. If at all possible, imagine the patient as being able to communicate and voice his/her opinions no matter how ill. This will serve as a guide as to what is necessary to make a patient feel comfortable.

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The final issue that Perrin[15] recognized was sleeplessness. In the critical care unit, sleep may be disturbed for multiple reasons including the environment, healthcare interventions, various medications, and physical discomfort.[17] To alleviate these, the nurse should prepare the patient for sleep. A complete assessment including any intravenous lines, gastric tubes, ventilatory support, and catheters should be carried out. Any procedures should be completed. Consultation with the patient, if possible, is necessary to determine the most comfortable position. Offer pain and sleep medications or sedatives. Make certain that the patient's area is of a comfortable temperature, adding linens as deemed necessary to achieve this. Decrease lighting, activity, and noise, and allow the

patient at least 2 hours of uninterrupted sleep if possible.[15] All of these will contribute to the alleviation of sleep deprivation experienced in the critical care unit.

Addressing the psychological needs of the patient is always of utmost importance to critical care nurses, but physiological requirements cannot be overlooked. Knowing the idiosyncrasies of various patient populations is difficult but necessary. Most critical care nurses are highly educated about mechanical ventilation because it is one of the most common interventions seen in critical care areas, while caring for a patient with both HIV/AIDS and PCP may be less familiar.[18] The patient with HIV/AIDS has issues associated with pharmacological management. The administration of certain antiretroviral medications, the dosages, drug interactions, and toxic affects are some of the most crucial.[11]

Administration of antiretroviral medications is a challenge for critical care nurses. Unfortunately, there are few antiretrovirals that are available intravenously or in oral solutions.[11] All are available as capsules or tablets, but the absorption of these after being crushed or dissolved is questionable. Also, the acquisition of adequate plasma levels of antiretrovirals delivered in this manner is uncertain. Those medications that are sustained release or enteric coated cannot be crushed without compromising their effectiveness. These problems complicate the administration of these drugs to the unconscious or intubated patient. Although the use of a nasogastric tube or gastrostomy tube may alleviate the question of route, the healthcare provider must address the problems associated with altered plasma levels.

In addition to the problems with the administration, there is evidence to suggest that critical illness of any origin alters absorption of antiretroviral medications.[11] Such problems as decreased gastric motility, nasogastric suctioning, continuous feeding, and stress ulcer prophylaxis may have an adverse effect on medication absorption. Some antiretrovirals are taken with food for optimal absorption, whereas absorption of others is optimal when the stomach is empty.[12] Certain drugs, such as histamine 2 blockers and proton pump inhibitors, used in stress-ulcer prophylaxis, are contraindicated while taking some antiretrovirals.

Renal or hepatic insufficiency will alter drug dosages requiring dose adjustment as the insufficiency increases or decreases.[11,12] Some antiretrovirals are contraindicated in patients with renal or hepatic failure, with most fixed-dose nucleotide reverse transcriptase inhibitor combinations being prohibited in all patients with renal insufficiency. Consultation with an experienced healthcare provider is valuable in these instances.

Drug interactions between antiretroviral medications and other drugs are numerous.[12] Of particular interest to the critical care nurse is the use of such drugs as midazolam, phenytoin, and amiodarone. These drugs are contraindicated with the use of protease inhibitors and/or nonnucleoside reverse transcriptase inhibitors because of possible toxicity. Consultation with a pharmacist is suggested.

Another concern of critical care nurses is the toxic effects of prophylactic and antiretroviral therapy. Hypersensitivity reactions such as Stevens-Johnson syndrome, lactic acidosis, and toxic epidermal necrolysis are possible complications of administration of such drugs as stavudine , didanosine, or TMP-SMX.[11,12] These complications are handled by withdrawal of the causative agent. Severe cases of Stevens-Johnson syndrome and toxic epidermal necrolysis are treated as burns with supportive care. Corticosteroids are not indicated. It is advised that a diagnosis of lactic acidosis be made only after careful acquisition of venous blood.[12] Faulty sample procurement has been implicated in some cases.

CONCLUSION

Caring for a patient in a critical care area is fraught with complex issues. Psychological needs must be met along with physiological needs. Most critical care nurses deal with these daily. Care of the patient with PCP and HIV/AIDS occurs less frequently and presents added demands for the already limited time of critical care nurses. Pharmacological regimens are complex and difficult to understand. Administration of antiretroviral medications is uncertain because of limited research knowledge pertaining to unconventional medication administration and maintenance of drug plasma levels. Problems associated with drug interactions among many of the antiretroviral drugs and frequently used critical care drugs make medication administration complicated. Complications associated with drug therapies contribute to the complexity of ensuring that the patient receives optimal care that all critical care nurses strive to achieve. To add to all of these requirements, the critical care nurse must be aware of the ever-changing protocols associated with caring for multiple patient populations. This article addressed the issues associated with caring for the patient with AIDS and PCP. Hopefully, when the next patient with these conditions is admitted, the critical care nurse will call upon the information included here to assist him/her in caring for this patient.

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