Bronchoalveolar lavage (BAL) is often used to diagnose infectious, inflammatory, and neoplastic lung disease. The technique involves advancing a bronchoscope into a subsegmental bronchus and then infusing aliquots of fluid into the bronchus, after which the fluid is gently aspirated to avoid airway collapse. This procedure is relatively safe to perform on ill and/or immunocompromised patients and is used to diagnose a variety of viral, bacterial, and fungal diseases. When infectious organisms are suspected, special stains, such as Gomori methenamine silver (GMS) and acid-fast bacillus (AFB), may be performed to highlight organisms that may not be easily visible on routine hematoxylin-eosin (H&E) staining.

Our pathology department stains all BAL cytospin specimens for fungal and acid-fast microorganisms using GMS and AFB stains, respectively. Most hospitals do not perform these tests on all BAL specimens; instead, GMS and AFB stains are performed at the discretion of the pathologist, taking into account the clinical history of the patient and clinical suspicion that the patient may have one of the infections detected by these stains.

We assessed whether our policy was cost effective in a population consisting of military personnel, which are predominantly young, healthy adults, and also evaluated the delayed turnaround time for these specimens.
Materials and Methods

We retrospectively reviewed a total of 488 BAL specimens from Brooke Army Medical Center and Wilford Hall Ambulatory Surgical Center, both in San Antonio, TX, over a 2-year period from October 2010 through September 2012. We categorized each case as follows: negative for organisms, positive for fungal organisms, or positive for acid-fast organisms. We performed a cost analysis, including cost per case, cumulative cost over the 2-year period, and cost per specimen that tested positive. We then performed a review of the impact of these additional stains on turnaround time.

Results

We reviewed 488 BALs from October 2010 through September 2012, a total of 295 men (60.5%) and 193 women (39.5%). Four specimens tested positive for malignant neoplasms, and 1 yielded suspicion of malignant neoplasm. Three specimens proved to be unsatisfactory for evaluation due to lack of pulmonary macrophages; 5 others had noncontributory stains due to suboptimal GMS or AFB staining or failure of controls. A total of 35 (7.1%) specimens tested GMS positive, and 2 specimens (0.41%) tested AFB positive. Of the 35 specimens that tested GMS positive for organisms, 34 showed morphologic features of Candida, likely due to oropharyngeal contamination. Most of these cases with features of Candida were identified with GMS special stain (86.0%); the pseudohyphae and yeast forms were not visible on routine Diff-Quik (Polysciences, Inc., Warrington, PA) and Papanicolaou-stained slides. However, 5 of these specimens had identifiable fungal elements morphologically consistent with Candida on routine stains. One specimen (0.002%) had features consistent with Pneumocystis organisms. The morphologic features were evident on routine stains, including the typical frothy exudate present on the Papanicolaou stain. The GMS special stain then confirmed the presence of the cup-shaped cyst walls of the organisms.

Of the 2 AFB-positive individuals, 1 had a history of active tuberculosis and collapse of the lobe of the left upper lung. The other had dry cough and bilateral pulmonary nodules on chest X-ray. Results of an AFB culture were negative; however, the patient was treated for atypical mycobacterial pneumonia. For both specimens, the AFB stain was necessary to identify the organisms. The patient whose BAL results were positive for Pneumocystis had anemia, symptoms of pneumonia, high suspicion for being immunocompromised, and bibasilar opacities on chest X-ray.

The GMS staining kit costs our institution $804.00 per box of 75 slides; the AFB kit costs $669.00 per box of 75 slides. Per case, the cost of GMS stain is $10.72; the cost of AFB staining is $8.92; the cost for both is $19.64. Technician labor for slide preparation is estimated at $5.26 per specimen. Therefore, the total cost of GMS and AFB stains is $24.90 per case. Over 2 years, including 488 specimens, the direct cost of these tests was $9,584.32. Adding the technical cost of $2,566.88, GMS and AFB stains cost our institution $12,151.20 for 488 cases over 2 years.

Conclusion

GMS and AFB stains are useful to detect infectious organisms in BAL specimens. The sensitivity and specificity of GMS are approximately 60% and 100%, respectively, and for AFB, 20% to 40% and 87%, respectively. Missing an infectious etiology in a patient can have serious consequences; thus, our institution initiated a policy to perform GMS and AFB special stains on all BAL specimens to maximize detection of these infectious organisms.

Most hospitals do not reflexively perform GMS and AFB stains; we questioned the necessity of reflexive GMS and AFB testing in our military-centered patient population. Most of our patients are active duty military personnel; however, military hospitals also serve the older veteran population. Compared with our civilian counterparts, however, we do not currently have a higher volume of older and presumably less healthy patients at our hospital. Our institution has a bone marrow transplantation service, although its volume is likely less than that of a civilian academic hospital. Therefore, we do not believe that reflexive testing is necessary based on our relatively healthier patient population, compared with that of large institutions that treat a higher concentration of immunocompromised patients in the United States.

The incidence of active pulmonary tuberculosis in the United States (US) military, even when corrected for pos-
sible underreporting, was 0.87 per 100,000 person-years between 2004 and 2006.7 In our study, only 2 of 488 specimens tested AFB positive for acid-fast organisms, or 0.41% of total specimens; the cost of processing these specimens was $4,352.96, not including labor. In these 2 cases, at the time of the procedure, healthcare professionals knew of a history of active tuberculosis or had clinical suspicion of atypical pneumonia.

The rate of Pneumocystis infection in the military population is low. Most patients with Pneumocystis infection are immunocompromised in some way, particularly if they harbor human immunodeficiency virus (HIV). Although the rate of HIV infection in the military is higher than the US general population (0.15 to 0.2 per 1,000 active duty personnel in 20099), the incidence of patients with AIDS developing Pneumocystis infections has been reduced with the introduction of highly active antiretroviral therapy (HAART). In our study, our laboratory spent a total of $5,231.36 (not including labor) for GMS testing, yielding a single positive result for Pneumocystis, for which clinical suspicion was already high because the patient was immunocompromised. In this case, there also is potential for monetary and labor savings because it has been shown8 that the Papanicolaou stain alone can lead to a diagnosis of Pneumocystis with reliable sensitivity and specificity (98.3% sensitivity with a 1.7% false negative rate9).

Potential savings for technical labor in preparing GMS and AFB slides amounted to $2,566.88 for the 488 specimens over 2 years. Regarding turnaround time, the cases are delayed 3.0 to 3.5 hours (for cytospin slide preparation and AFB or GMS staining). Also, if technicians performed staining in the late morning or afternoon, results would not be available to the pathologist for interpretation until the next day.

Cost-effective healthcare is a priority for all healthcare institutions, including those who serve military personnel and veterans. Laboratory use is under intense scrutiny; healthcare professionals must involve the pathology department in the approval of laboratory tests. The impetus for this project was the desire to enhance productivity when cytopathologists review cases, and an overall reduction in cost for the laboratory by re-evaluating the necessity of testing algorithms.

AFB and GMS testing of 488 BAL specimens cost $12,151.20 (including technical labor), and identified 3 patients with clinically significant infections by acid-fast or fungal organisms. This study supports discontinuation of routine GMS and AFB testing as a cost-saving tool for hospitals serving healthy populations. Our analysis may serve as a model for institutions that may seek to limit the impact of unnecessary laboratory tests on their departmental budgets. The rising cost of medical care is a widespread concern. The pathologist and/or the healthcare professional should be involved in the decision as to whether or not special stains are necessary.

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References


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