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Review

The Synergistic Role of Endoscopy and Cytology in the Diagnosis of Aspergillosis: A Comprehensive Review of Human and Avian Medicine

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ABSTRACT

The use of endoscopy and cytology for the diagnosis of aspergillosis has gained significant attention in recent years due to its accuracy and reliability. The present literature review highlights the potential advantages of combining these two techniques in diagnosing aspergillosis, including the ability to visualize affected tissues and detect the presence of fungal elements. The use of endoscopy and cytology is applicable both in Human and Avian medicine which provides a rapid diagnosis, earlier treatment, and improved patient outcomes, making these techniques valuable to diagnose aspergillosis.

Keywords: Aspergillosis, endoscopy, isoflurane, ketamine, cyto-diagnosis

INTRODUCTION

The endoscopic diagnosis of aspergillosis allows for the visualization of the affected tissues, such as the lungs, sinuses, and gastrointestinal tract. It can help to identify the presence of fungal lesions or other characteristic changes in the tissue, such as granulomas or nodules. In a study by Vanita et al. (2021), endoscopic findings in patients with chronic rhinosinusitis with nasal polyps showed that the presence of fungal debris was highly suggestive of fungal sinusitis, including aspergillosis (1). Cytology, on the other hand, involves the microscopic examination of cells or tissues to detect the presence of Aspergillus spores in samples including bronchoalveolar lavage fluid, sputum, biopsy specimens, and aspirates. A study performed in 2019 found that the sensitivity and specificity of cytology in diagnosing pulmonary aspergillosis were 80% and 100%, respectively (2).

Advantages of Combined Endoscopy and Cytology procedures

Combining endoscopy and cytology can further improve the diagnostic accuracy of aspergillosis. Endoscopic examination and cytological analysis of bronchial brushing specimens showed a sensitivity of 94% and a specificity of 100% in diagnosing pulmonary aspergillosis (3,4). Various techniques have been developed to improve the detection of Aspergillus spores using endoscopy and cytology. For instance, immunohistochemistry can help identify the presence of Aspergillus antigens in tissues, while polymerase chain reaction (PCR) can detect Aspergillus DNA in samples. Recent studies showed that combining endoscopic biopsy, cytology, and PCR can increase the sensitivity and specificity of diagnosing aspergillosis (5,6). The major advantage of a combined procedure includes the following.

1.One of the advantages of using the combination of endoscopy and cytology procedures was the rapid and accurate diagnosis that allows for timely treatment and improved patient outcomes.

2.Endoscopy is a minimally invasive procedure that could be performed in an outpatient setting providing real-time visualization of the affected tissues. It allows the immediate identification of abnormalities or lesions and characteristic tissue changes. Additionally, endoscopy can be performed in multiple locations, including the sinuses, lungs, and gastrointestinal tract, allowing for identification of the site of infection.

3.Cytology involves the examination of cells or tissues in samples obtained non-invasively, such as through sputum or bronchoalveolar lavage.

Overall, the rapid diagnosis provided by the combination of endoscopy and cytology can lead to earlier treatment and improved patient outcomes, making these techniques

valuable in diagnosing aspergillosis.

A Comparative Study of Human and Avian Endoscopy

There are some differences in the techniques used in human and avian endoscopy due to the anatomical and physiological differences between the species. The difference in human and avian endoscopy procedures are the following.

1.One of the main differences is the species-specific anatomical differences in the respiratory system of avian species that differs from mammals, which can affect the type and location of lesions and the ability to obtain adequate samples for diagnosis (6).

2.Another difference is in the type of endoscopy equipment used in veterinary that is smaller in size and different shapes to accommodate the anatomical differences between species. In humans, a flexible fiberoptic endoscope has been used, while in avian species, a rigid endoscope is preferred due to the smaller size of the avian respiratory system (6). A rigid endoscope in birds allows for a better view of the affected areas and can also reduce the risk of trauma to the delicate tissues of the respiratory system.

3.Additionally, there may be differences in the clinical signs and symptoms exhibited by humans and animals with aspergillosis. For example, avian aspergillosis may present with respiratory distress, lethargy, and anorexia, while human pulmonary aspergillosis may present with coughing, fever, and shortness of breath (6).

4.Another difference is in the anesthetic management required for endoscopy. In humans, sedation or general anesthesia was used, while in birds, anesthesia is necessary to prevent stress and injury during the procedure (6-8). The choice of anesthetic agent and monitoring techniques may also differ between species.

In human endoscopy, sedation or general anesthesia is commonly used to provide comfort to the patient and minimize the risk of complications. Sedation is achieved by using intravenous medications such as midazolam and fentanyl, while general anesthesia may require the use of inhaled anesthetics or muscle relaxants (7,8). The choice of anesthetic technique will depend on the patient's age, medical history, and the type and duration of the procedure.

Sedation is one commonly used technique in human endoscopy, which involves the administration of intravenous medications to relax the patient and reduce their anxiety. The most used sedative medications include benzodiazepines such as midazolam and diazepam, and opioids such as fentanyl or propofol (7,8). General anesthesia might be used in endoscopic procedures, particularly for longer or more invasive ones. General anesthesia involves the administration of inhaled anesthetics, muscle relaxants, and other medications to induce and maintain a state of unconsciousness during the procedure (7,8).

Anesthesia is used for diagnostic and therapeutic procedures like endoscopy in avian medicine to minimize stress and prevent injury to the bird. However, the anesthesia management in avian medicine is different from that used in human endoscopy due to the unique physiology of birds. Injectable anesthesia is the most used technique in avian endoscopy that were ketamine, propofol, and tiletamine-zolazepam (6-8). These drugs are administered either intramuscularly or intravenously, and their effects are quickly reversible.

Isoflurane is a halogenated ether, the most used inhalant anesthetic agent widely used in avian medicine (9). It has a rapid onset and offset of action, allowing for rapid induction and recovery time. Isoflurane also has a low solubility in blood, which enables the adjustment of anesthesia depth during the procedure. Administration of isoflurane was typically vaporized in a carrier gas, such as oxygen or air, and delivered via a face mask or an endotracheal tube. The concentration of isoflurane in the carrier gas was adjusted according to the bird's response to the anesthetic and monitoring the bird's respiratory and cardiovascular parameters is essential during the procedure (9).

Despite these differences, the principles of endoscopy and cytology for the diagnosis of aspergillosis are similar between human and veterinary medicine. Both rely on the visualization of affected tissues and the detection of Aspergillus spores in samples obtained via endoscopy and cytology. Overall, the use of endoscopy and cytology has shown great potential for the diagnosis of aspergillosis in both human and veterinary medicine, with the potential to improve early detection and treatment outcomes (9-17).

Endoscopic Diagnosis of Aspergillosis

During an endoscopy, characteristic signs of aspergillosis may include the presence of nodules or growths on the lining of the respiratory tract. These growths can appear as whitish-yellow patches or raised, reddish bumps (**Figure 1**).

The tissue surrounding the growths may also appear inflamed or irritated. Aspergilloma, also known as a fungal ball, is a mass of Aspergillus fungus that grows within a pre-existing cavity in the lungs. The appearance of aspergilloma through endoscopy may vary depending on the size and location of the fungal ball (**Figure 2**). It can appear as a round, solid mass, white or yellow colored (14-17). The surrounding tissue may also

appear inflamed or irritated. In severe cases, sporulating colonies may be seen (**Figure 3**).

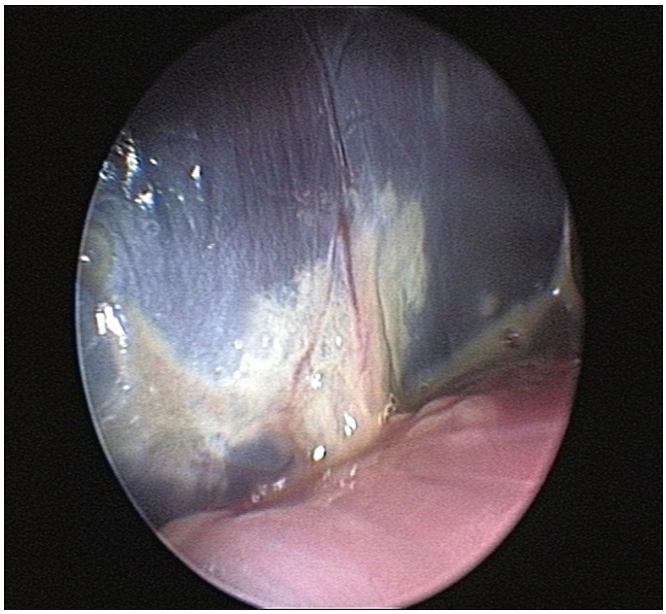

Figure 1. Endoscopic view of disseminated aspergillosis in the air sac of a Gyrfalcon (Falco rusticolus), the largest of the falcon species.

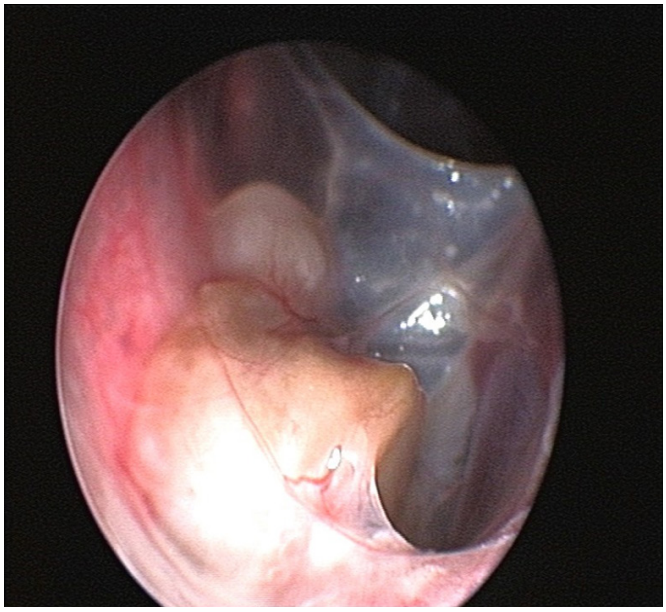

Figure 2. Aspergilloma in the air sac of a Gyr-Peregrine hybrid falcon.

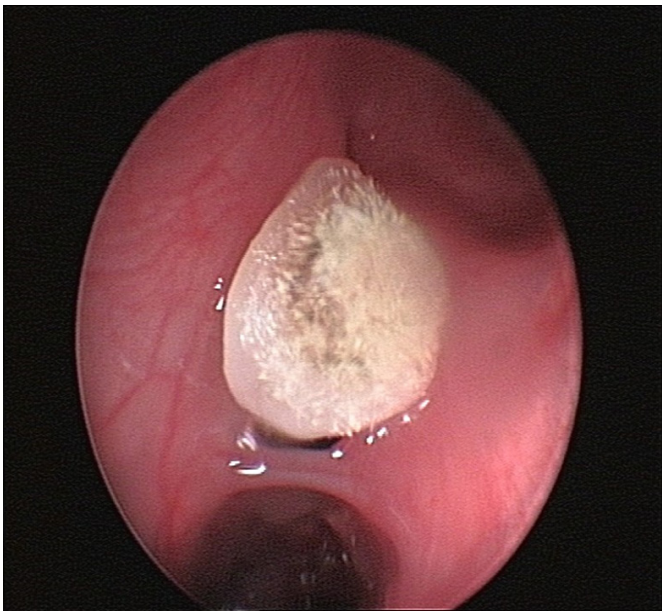

Figure 3. Sporulating aspergillosis in the air sac of a Gyrfalcon (Falco rusticolus).

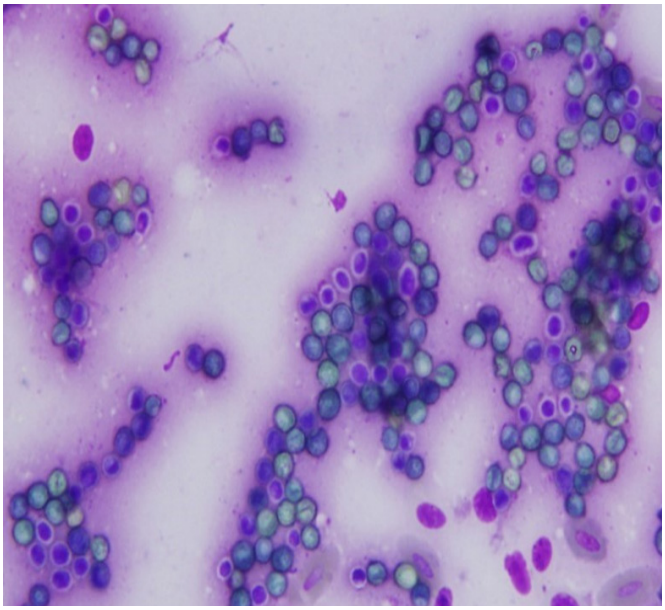

Figure 4. Cytology from the air sac of a Gyrfalcon (Falco rusticolus) with aspergillosis showing numerous fungal spores.

Diagnostic Cytology of Aspergillosis

The diagnosis of aspergillosis through cytology includes the appearance of fungal elements and cellular changes depending on the site of infection and the type of specimen obtained for analysis. Pulmonary aspergillosis is the most common form of aspergillosis, in which sputum or bronchoalveolar lavage (BAL) fluid is collected for cytological examination (10-13).

Microscopic examination of sputum or BAL fluid may reveal characteristic fungal elements, such as spores, conidiophores, and septate hyphae with acute-angle branching, which are typical of Aspergillus species (**Figure 4**). The cellular changes seen are necrotic tissue, inflammatory cells, multinucleated giant cells, and mucus. The presence of Aspergillus hyphae in tissue specimens, identified by histological examination or fungal cultures, is a hallmark of invasive Aspergillosis (**Figure 5**).

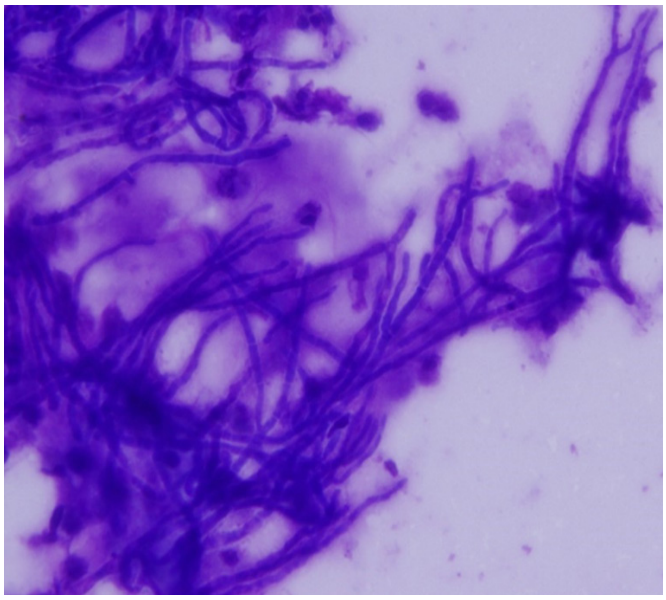

Figure 5. Cytology from the air sac of Gyrfalcon (Falco rusticolus) with aspergilloma showing fungal hyphae.

CONCLUSION

The use of endoscopy and cytology in the diagnosis of aspergillosis has gained significant attention in recent years due to its accuracy and reliability. The present literature review highlights the potential advantages of combining these two techniques in diagnosing aspergillosis, including the ability to visualize affected tissues and detect the presence of Aspergillus spores. It can be performed on a wide range of samples, including bronchoalveolar lavage fluid, sputum, biopsy specimens, and aspirates. Therefore, cytology can be a valuable tool in the diagnosis of aspergillosis, especially when combined with other diagnostic methods. Combining endoscopy and cytology can further improve the diagnostic accuracy of aspergillosis.

Various techniques have been developed to improve the detection of Aspergillus spores using endoscopy and cytology, immunohistochemistry, and PCR. These methods can increase the sensitivity and specificity of diagnosing aspergillosis, especially in cases with atypical presentations or immunocompromised patients. The use of endoscopy and cytology in the diagnosis of aspergillosis has shown promising results in recent studies, and combining these techniques can further improve the accuracy of diagnosis.

DECLARATIONS

Ethics Committee Approval Number: Not available
Informed Consent Form: Not available
Referee Evaluation Process: Externally peer-reviewed.
Conflict of Interest Statement: Not available
Author Contributions: Not available

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