

Microbiological study of role of fungi in primary atrophic rhinitis

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Abstract

Background: Fungal rhinosinusitis has gained much attention in recent years. To our knowledge, no previous studies have addressed the role of fungus in primary atrophic rhinitis.

Study design: Prospective case study.

Patients and methods: All cases of primary atrophic rhinitis presenting to the out-patient department at El-Sahel Teaching Hospital over a five-month period were included in the study. Crusts and purulent secretions removed from patients' nasal cavities underwent microbiological analysis at the Medical Microbiology and Immunology department of the Cairo University Faculty of Medicine. Special emphasis was placed on fungal isolation.

Results: Fourteen consecutive cases of primary atrophic rhinitis were studied in the five-month period starting 26 November 2007. Patients comprised eight females and six males, with an age range of 12 to 65 years (mean 37 years). Microscopy of the crusts and purulent secretions showed pus cells in most of the samples. *Klebsiella* species were isolated from nine patients (65 per cent), and other bacterial species were isolated in most of the remainder. Fungal elements, most commonly *aspergillus* species, were isolated in 13 patients (93 per cent).

Conclusion: It is proposed that the initial trigger for primary atrophic rhinitis is a virulent bacterial infection of the nasal lining, which leads to damage of the ciliated epithelium. This initiates the cascade of events leading to inflammation of the mucosa and submucosa, with secondary pyogenic osteomyelitis of the turbinate bone. The persistence of purulent secretion, within the setting of impaired mucociliary clearance, leads to saprophytic fungal colonisation which contributes greatly to the clinical picture.

Key words: Atrophic Rhinitis; Microbiology; Fungi

Introduction

Primary atrophic rhinitis is a chronic nasal disease characterised by progressive nasal mucosal atrophy, progressive atrophy of the underlying turbinate bones, abnormal widening of the nasal cavities, and formation of viscid secretions and dried crusts leading to a characteristic fetor (*ozaena*).¹ Numerous theories have been proposed to account for the pathogenesis of this condition.^{1,2}

Although fungal rhinosinusitis has gained much attention in recent years, the role of fungi in the pathogenesis of primary atrophic rhinitis is scarcely documented in the literature. A search of the PubMed/Medline database failed to identify fungal studies in this condition in humans. In humans, *Klebsiella ozaenae* has been isolated with relative frequency from patients with primary atrophic rhinitis.³ However, as far as the authors are aware, no specific fungal studies have been performed on

the crusts and secretions associated with this condition in humans.

The aim of this study was to microbiologically examine the organisms involved in primary atrophic rhinitis, with special emphasis on fungal elements. For this purpose, we recruited all cases presenting to a single institution over a five-month period.

Patients and methods

The subjects comprised patients with primary atrophic rhinitis who presented consecutively to the out-patient department at El-Sahel Teaching Hospital over a five-month period, commencing on 26 November 2007. The criteria for diagnosis and inclusion in the study included nasal crusting, enlarged nasal cavities, resorption of the turbinates, mucosal atrophy and paradoxical nasal congestion,

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TABLE I
MICROBIOLOGICAL DATA FROM THE STUDY GROUP

Pt no	Age (yr)	Sex	Sample		Microscopy	Bacterial isolate	Fungal isolate
			Date	Type			
01	25	F	26/11/2007	Nasal crust	Pus cells >100 Rare epithelial cells Few G -ve bacilli	Pseudomonas spp	Aspergillus spp (<i>A niger</i>)
02	22	F	26/11/2007	Nasal crust	Pus cells 20-25 Rare epithelial cells No bacteria	Klebsiella spp	<i>A flavus</i> + candida spp
03	25	M	5/12/2007	Nasal crust	Pus cells >100 Many epithelial cells No bacteria	Klebsiella spp	Penicillium spp
04	42	M	6/12/2007	Nasal crust	Pus cells >100 Few epithelial cells Pneumococci ++	Klebsiella spp	Aspergillus spp
05	21	F	24/1/2008	Nasal crust	Pus cells 10-15 Few epithelial cells Many encapsulated G -ve bacilli	Klebsiella spp	None
06	38	F	11/2/2008	Pus from R nasal cavity	Pus cells 8-10 Rare epithelial cells No bacteria	Klebsiella spp	Aspergillus spp
07	51	M	2/3/2008	Nasal crust	Pus cells 8-10 No epithelial cells Many G + ve cocci	<i>Streptococcus pneumoniae</i>	<i>A niger</i>
08	65	M	24/3/2008	Nasal crust	Pus cells >100 Rare epithelial cells Moulds with septate hyphae	Klebsiella spp	<i>A niger</i>
09	23	F	26/3/2008	Nasal crust	Pus cells 8-10 Rare epithelial cells	Klebsiella spp	Penicillium spp
10	48	F	2/4/2008	Nasal crust	Pus cells 2-4 Rare epithelial cells No bacteria	Coagulase -ve staphylococci (normal commensals)	<i>A niger</i>
11	60	F	3/4/2008	Nasal crust	No pus cells Rare epithelial cells Many G -ve bacilli	Klebsiella spp	Rhizomucor spp
12	22	M	4/4/2008	Nasal crust	No pus cells No epithelial cells Some G + ve cocci	<i>Escherichia coli</i>	Alternaria spp
13	12	F	13/4/2008	Nasal crust	Pus cells 2-4 Rare epithelial cells	Pseudomonas spp	<i>A flavus</i>
14	43	M	21/4/2008	Pus from R nostril	Pus cells 20-25 G -ve bacilli	Klebsiella spp	Aspergillus spp

Pt no = patient number; yr = years; F = female; M = male; G -ve = Gram-negative; G + ve = Gram-positive; spp = species; R = right

in the absence of previous surgery or presence of a specific granulomatous disease.⁴

Crusts were removed from the nasal cavity by sterile forceps and placed in a sterile container for prompt microbiological analysis at the Medical Microbiology and Immunology Department, Faculty of medicine, Cairo University. Initially, microscopic examination of the sample was performed after Gramstaining. Bacterial culture was performed on blood agar, chocolate agar and MacConkey medium. Fungal culture was performed on Sabouraud's dextrose agar. The stains used for microscopic examination of isolates were Gram stain for bacteria and lactophenol cotton blue stain for fungi.

Approval for the study was obtained from the ethical committee at the General Organisation for Teaching Hospitals and Institutes, Cairo.

Results

The study group comprised 14 patients, eight females and six males, aged from 12 to 65 years (mean 37 years). The patients presented with fetor and nasal obstruction. Two patients reported significant epistaxis associated with removal of crusts. The cases reported had not received antibiotic treatment over the two months prior to presentation.

The results of the microbiological study are shown in Table I. Pus cells were commonly seen on direct microscopic examination. The bacteria isolated from cultures comprised klebsiella species (in nine patients, 65 per cent) and others (including *Pseudomonas aeruginosa*, *Escherichia coli* and *Streptococcus pneumoniae*). Fungal cultures were positive in 13 patients (93 per cent), with the predominant fungi isolated being aspergillus species; candida, rhizomucor and alternaria species were also isolated.

Discussion

This study isolated fungal elements from the majority of specimens (93 per cent) obtained from patients with primary atrophic rhinitis. As far as we are aware, no previous study has focussed on the presence of fungi in the crusts and secretions of such patients. Generous biopsies were taken from the inferior turbinates of three patients under general anaesthesia, during surgery for unilateral closure of the nasal vestibule (Young's procedure). Histopathological examination did not reveal fungal invasion of the nasal tissues (Figure 1). Non-invasive fungal sinusitis affects immunocompetent hosts and is broadly classified into allergic fungal sinusitis and saprophytic fungal colonisation.⁵ The elements necessary for diagnosis of allergic fungal sinusitis, such as nasal polyps and eosinophilic mucin, were absent in our patients; therefore, it may be concluded that the fungal elements detected in this study represented saprophytic fungal colonisation.⁶

The predominant bacterial species previously isolated from cases of primary atrophic rhinitis has been *Klebsiella ozaenae*.³ Klebsiella species are capsulated, enteric, Gram-negative, rod-form bacilli.⁷ These were isolated in 65 per cent of our patients (Table I). Other cultured bacteria were predominantly Gram-negative

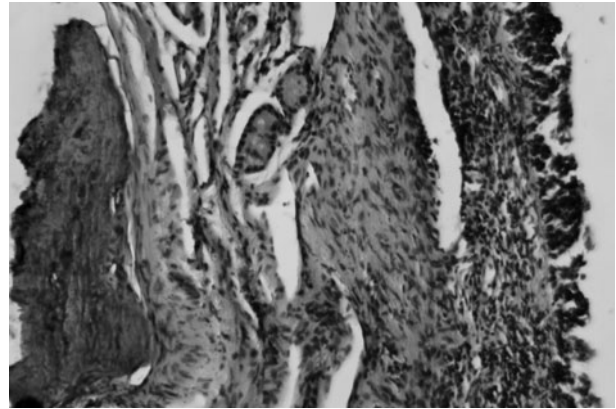


FIG. 1

Photomicrograph of lateral nasal wall biopsy from patient with primary atrophic rhinitis, showing squamous metaplasia of epithelium, chronic inflammatory cells, hyper vascularity, submucosal fibrosis and necrosis of underlying bone (H&E; ×150).

rods. It has been found that the bacterial lipopolysaccharide of Gram-negative organisms causes ciliostasis of the mucosal epithelium,⁸⁻¹⁰ thus accounting for the persistence of infection. Bacterial colonisation takes the form of a bacterial biofilm, making the organisms resistant to host defences and antibiotics.¹¹ The presence of pus cells was a common finding in microscopic examination of the discharge obtained from our patients (Table I). Histopathological examination of biopsy material revealed inflammatory cells in the submucosa and necrotic inferior turbinate bone, consistent with chronic pyogenic osteomyelitis (Figure 1).¹² Chronic osteomyelitis accounts for the bone loss seen in primary atrophic rhinitis; furthermore, it contributes to the persistence of the neighbouring mucosal disease.^{13,14}

- This study undertook microbiological analysis of crusts and secretions obtained from 14 patients with primary atrophic rhinitis
- Pyogenic bacteria were isolated from the majority of specimens; klebsiella species were encountered in 65 per cent and other pyogenic bacteria were also isolated (mostly Gram-negative rods)
- Fungal elements were isolated from 93 per cent of specimens, the most common being aspergillus species; the fungal infestation represented saprophytic fungal colonisation

The predominant fungi isolated from our patients were aspergillus species (Table I). The persistence of purulent discharge and impaired mucociliary clearance facilitates saprophytic fungal infestation, associated with germination of inhaled fungal spores. This fungal colonisation contributes to the offensive odour and the characteristic friable, cheesy material associated with crusts encountered in cases of primary atrophic rhinitis.¹⁵ Moreover,

pressure by the fungal mass may contribute to pressure atrophy of the turbinate bone.^{16,17}

Conclusion

The pathogenesis of primary atrophic rhinitis probably involves virulent bacterial infection of the mucosa, with secondary inflammatory effects on the submucosa and bone. Saprophytic fungal colonisation of the purulent discharge contributes to the clinical picture of the disease.

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