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Peritonitis due to *Geotrichum candidum* in Continuous Ambulatory Peritoneal Dialysis

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Abstract

This paper is a report of a 34-year-old man with chronic renal failure undergoing Continuous Ambulatory Peritoneal Dialysis which developed peritonitis due to *Geotricum candidum*. The diagnosis was established by culture of dialysis fluid. The purpose of this report is to provide data on a fungal peritonitis due to a non-common agent.

Keywords

Peritonitis, Fungal Peritonitis, *Geotrichum candidum*, Continuous Ambulatory Peritoneal Dialysis

1. Introduction

Peritonitis is the main complication of Continuous Ambulatory Peritoneal Dialysis (CAPD) [1] [2] [3]. Bacterias are responsible for the main part of the cases, peritonitis by fungi is non-frequent, only about 1% to 23% of the reported series. Candida is the most common agent, implicated in 80% - 90% of the fungi peritonitis cases. Kavanagh in a study realized from 1999 to 2002 in Scotland concluded that fungi infections regarded 3.4% of all reported cases [4]. In Latin America, Gadola found 2 cases of fungi in 144 cases of peritonitis. Russi *et al.*, in a 5-year study, in 149 cases of peritonitis found that 8.1% of cases were related to fungi. *Candida albicans* was isolated in 6 cases [2]. In India Indhumathi *et al.*, on a 7 year period found 30 cases of fungal peritonitis in CAPD [5]. The common fungus was Candida species (50%). In Argentina, in a period of 25 years, 183

episodes of peritonitis were found in 57 patients, fungi were identified in 8 episodes, the responsible agents were *Candida albicans* in 5 episodes, *Candida parapsilosis, C. glabrata* and *Neosartorya hiratsukae* in the other 3 episodes [6]. Manzano *et al.*, in a study realized in Mexico City, found 15 cases of fungal peritonitis, in which 10 cases corresponded to Candida [7]. Other fungi as *Fusarium*, *Aspergillus*, *Nocardia*, *Penicillium* [1], *Cryptococcus* [8], *Torulopsis*, *Trichosporon* [9], *Histoplasma* [10] [11], *Paecilomyces* [12] [13] [14] [15] [16], *Prototheca* [17] [18], *Rhizopus* [19], *Agrobacterium* [20], *Saccharomyces* [21], *Exophiala* [22], *Rhodotorula* [23] and others [24] [25] [26] [27] have been reported as responsible agents of peritonitis in CAPD.

Introduction of fungi to peritoneal cavity is due to contamination by contact or direct extension of infection in the catheter outlet through the subcutaneous tunnel and to the peritoneum. The fungi enter the peritoneal cavity through intraluminal and periluminal ways, going through the intestinal mucous membrane, and through hematogenous ways, starting from a distant fungal infection. [28] The importance of this type of peritonitis depends on the morbidity and mortality and as the main cause of technical failure [1] [2] [3] [4]. García Martos *et al.*, in a study of 10 cases of fungal peritonitis in continuous ambulatory peritoneal dialysis, found a high mortality rate associated with this condition (40%) [29]. Risk factors which predispose development of fungal peritonitis have been identified as long antibiotic treatment, recent episodes of bacterial peritonitis, extraperitoneal infection by *Candida*, immunosuppression, hospitalization, prolonged stay of permanence in a dialysis program, prolonged stay of insertion of peritoneal catheter and advanced age [4] [28] [29] [30].

Clinical manifestations of fungal peritonitis are similar to bacterial peritonitis, guidelines in fungi peritonitis are the continuous turbid aspect of dialysis fluid, permanent or crescent symptoms despite antibiotic treatment and negative initial culture. The real value of Gram stains depends on the observation of ferments or hyphae, meanwhile, culture requires a long time. Identification is the most important data, used to support the early diagnostic and to establish a correct treatment.

Results of antifungal treatment are contradictory. Amphotericin B, Fluorocytosine, Ketoconazole, Miconazole, Econazole, Fluconazole, recently Posaconazole and Voriconazole are the most common antifungal used.

Fluconazole has some advantages in relation to other antifungals, its versatility to be applied orally or intraperitoneal, its bioavailability in peritoneal cavity when administered orally or intravenously and good tolerance are the main benefits.

It must be noted that ideal antifungal therapy has not been yet identified, this includes the dosification, routes of administration or the treatment time, even though it has been established a minimum of 2 weeks. Prophylaxis with Fluconazole (100 mg/day), Ketoconazole (200 mg/day) or Nystatin has demonstrated its effectiveness in the reducing the incidence of fungal peritonitis in patients

with prolonged antibiotic therapy and immunocompromised [3] [4] [28] [29] [30].

The treatment implies the early withdrawal of the catheter and the administration of antifungal drugs. The maintenance of the catheter once the infection has been detected is associated with a worst outcome, constituting the main triggering factor in the failure of the technique and rise in mortality. Therefore, once the catheter has been removed, according to the guidelines antifungal agents should be continued for at least 2 weeks [31] [32] [33].

The purpose of the present report is to inform what we consider as the first case of peritonitis in CAPD by *Geotrichum candidum* in Mexico and probably in the world.

2. Case Report

A 34-year-old man with hypertension and nephrolithiasis with 4 years of evolution, a carrier of chronic renal failure since 1992. Was integrated to the CAPD program since April 1993. He had two episodes previous of bacterial peritonitis. In October 1993 he developed abdominal pain associated to cloudy dialyzate, the white cell count showed 90 cells/mm^3 with an increase in polymorphonuclear cells (normal value fewer 100 cells) with a reported culture of fungi without identification of the agent. He received Fluconazole treatment by 10 days with an adequate response. The sample was sent to the Instituto de Ciencias de la Benemérita Universidad Autónoma de Puebla (ICBUAP) which reported it as *Geotrichum candidum*. The patient was admitted in December due to edema, abdominal pain and cloudy dialyzate, during physical examination peritoneal irritation was found, cell counts showed 74 cell/mm^3 with an increase in polymorphs (80%), direct microscopy and Gram stain were negative. The catheter was retired at the eight day of hospitalization due to the persistence of the symptoms, despite antimicrobial treatment. He was discharged asymptomatic.

Dialysis fluid sent to ICBUAP was reported as *Geotrichum candidum* growth.

He was admitted in January 1994 for new peritoneal dialysis which failed due to peritoneal septum and therefore transferred for hemodialysis.

After the transfer of the patient, contact with him was lost, his health status is currently unknown.

3. Discussion

Geotrichosis is an infrequent opportunistic mycosis caused by yeasts. The main etiologic agent is *Geotrichum candidum*, which belongs to the class Hemiascomycetaceae, order Saccharomycetales, family Dipodascaceae. It has been reported to pathologically affect the bronchi, lungs, and bowel, and only seldom the mouth, skin, and nails. Two other species have also been reported to affect the lung: *Geotricum capitatum* and *Geotrichum clavatum.*

G. candidum is a cosmopolitan microorganism and habitual contaminant. It has been isolated from various sources such as fruits and vegetables, soil, water, air, plants, and sewage. Several studies have proven that it is a commensal in

humans and part of the normal flora of the skin, mouth, bronchi, lungs, gastrointestinal and genitourinary tracts [34] [35] [36].

Geotrichum candidum (Link and Persoon 1822) is a yeasty fungus present in nature in sexual or asexual forms. It grows in the majority of cultures and is inhibited by actidione (cycloheximide). Development is fast, 3 to 5 days during incubation, up to 25˚C to 37˚C, it forms white yellowish colonies which are flat, moisty and hairy. Microscopically, it forms coarse true hyphae that segment into rectangular arthroconidia which vary in length (4 - 10 μm) [37]. When cultures are incubated to 37˚C they acquire round forms. Buttler and Petterson described the perfect state called *Endomyces geotrichum*. There are other species of *Geotrichum* which belong to the normal flora, they differ from *G. candidum* due to the production of blastospores.

G. candidum cannot ferment carbohydrates, uses glucose and occasionally lactose, it is negative for urease, does not resist tetrazolium salts and does not use potassium nitrate. The poor biochemical activity of *G. candidum* along with the morphological absence of blastoconidia produced along the hyphae help to distinguish *G. candidum* from other yeasty fungi such as *Trichosporon* spp, *Candida*, and *Saccharomyces* [37] [38].

Geotrichum was found initially by Link in 1809. Bennet in 1842 described the organism as a cause of superinfection in an old tuberculous cavity, though the case was reported as "*Monilia*" (*Candida*), it may represent the first reported case of geotrichosis.

Confusion with infections caused by *Candida* or isolation of the organism from the normal flora invalidates most of the early records of *Geotrichum* as a fungal pathogen. Reports of pulmonary geotrichosis made by Linossier in 1916 and Martin in 1928 are probably authentic.

Description of the organism in eczematous dermatitis during 1935 by Cifern and Redaelli probably represent isolation of normal flora from a pathogenic process of different etiology. Geotrichosis is usually secondary to some other debilitation, such as tuberculosis, a complication of steroid therapy, diabetic patients, AIDS, or an oncological pathology, in overall presenting in the immunocompromised host [38]. André *et al.* reported the case of septicemia due to *Geotrichum candidum* in a child with hepatoblastoma [39]. Ng and his group reported a disseminated *G. candidum* infection in a 4-year-old patient with acute lymphoblastic leukemia [40]. In a study reported by Bonifaz *et al.*, in 12 cases of oral geotrichosis, found 8 diabetic patients, 2 patients with acute lymphoblastic leukemia, 1 patient with AIDS and a patient with Hodgkin's lymphoma [34]. Myint's group described a case of postoperative fungal endophthalmitis due to *G. candidum* in a diabetic patient [37].

Schnoor isolated the fungus in 29% of 314 stool specimens obtained from healthy people. On another study, based on samples from sputum, feces, urine and vaginal secretions of 2643 patients, 18% to 31% specimens were isolated, though they were not associated to another specific sickness [41].

G. candidum is also found naturally in cheese and fermented milk, but in France, it has been added as a ripening agent for at least thirty years, reported by the International Dairy Federation and European Food and Feed Culture Association as a microorganism with a documented history in dairy products [42].

In an attempt to understand the pathogenicity of fungi in general, special emphasis has been made on their ability to developed biofilms, not only as protection against the environment but as a special infectious reservoir that can lead to systemic infection.

In recent research, developed exclusively on *C. albicans*, by Harriott and Noverr, proved that biofilms had the capacity to attach on medical devices, such as catheters or mucosal host tissues, which provide an excellent environment for their development [43].

On further investigation performed by Barreto-Bergter and Figueiredo regarding the fungal glycans and the innate immune response, revealed that O-linked mannans were involved in the tissue colonization, while N-linked mannans were major determinants of the innate immune recognition. Special attention must be noted on the β-D-glucans and chitin as skeletal components of fungi, due to the fact they are virtually present in all fungi. The presence of the mentioned skeletal components induces cytokine production, reactive oxygen species (ROS), leukocyte recruitment and phagocytosis by neutrophils and macrophages, consequently with the induction of molecular mediators such as IL-1β, TNF, and IL-6, which would be responsible for the clinical manifestations of the patients [44]. Therefore, it would be correct to hypothesize that *G. candidum* uses the same molecular components to induce damage to the host.

We believe that in our case, the first episode of peritonitis was acquired during manipulation of dialysis bag changes, it must be noted that in the decade of the 90's, prolonged stay of permanence in a dialysis program along with the prolonged stay of insertion on the peritoneal catheter were not yet considered as risk factors for the development of fungal peritonitis. The first episode was treated with fluconazole during 10 days, which apparently resolved the infection, in order to confirm, cultures were taken, which reported negative results, therefore therapy was not continued and the catheter was not retired. According to current literature, besides the antifungal therapy, which must be done for at least 14 days, the early withdrawal of the catheter is fundamental in order to resolve the clinical episode. Withdrawal of the catheter is necessary to eradicate the infection due to the fact that it constitutes a primordial site of microbial colonization.

The patient was admitted for the second time, with suggestive data of fungal peritonitis, such as, persistence of cloudy dialyzate, abdominal pain, cellular counts with an increased number in polymorphonuclear cells, and null response to antimicrobial treatment, however it could not be confirmed because Gram stains were negative, therefore establishing the diagnosis by dialyzed fluid culture, with report of growth by *G. candidum*, hence the withdrawal of the catheter was realized. All of the above mentioned may have influenced the second infective

episode, at the removal the catheter, the symptoms disappeared, which suggest fungi colonization of the catheter and therefore the persistence of infection.

The International Society for Peritoneal Dialysis guidelines recommended that peritonitis can be diagnosed when at least 2 of the following are present: 1) clinical features consistent with peritonitis, i.e. abdominal pain and/or cloudy dialysis effluent; 2) dialysis effluent white cell count > 100/μL, with 50% polymorphonuclear; and 3) positive dialysis effluent culture. The white blood cells count in the effluent depends in part on the length of the dwell. For patients on CAPD with rapid cycle treatment, the clinician should use the percentage of PMN rather than the absolute WBC count to diagnose peritonitis, and a proportion above 50% is strong evidence of peritonitis, even if the absolute WBC count is less than 100/μL. In our case, the only criterion not reached was that of cellularity greater than 100 cells, probably due to rapid drainage of the liquid, covering the rest of the criteria indicated to establish the diagnosis.

Conflicts of Interest Statement

Manuscript title: Peritonitis due to *Geotrichum candidum* in Continuous Ambulatory Peritoneal Dialysis.

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