Case Report

Peritonitis due to *Neosartorya pseudofischeri* in an elderly patient undergoing peritoneal dialysis successfully treated with voriconazole

B. Ghebremedhin,1 A. Bluemel,2 K.-H. Neumann,2 B. Koenig1 and W. Koenig1

1Clinical Microbiology, University Clinic, Magdeburg, Germany
2Division of Nephrology, University Clinic, Magdeburg, Germany

Aspergillus peritonitis is a rare life-threatening complication of peritoneal dialysis (PD). We report a case of symptomatic *Neosartorya pseudofischeri* peritonitis in a 60-year-old woman treated by continuous ambulatory peritoneal dialysis (CAPD) for 13 months, who performed peritoneal exchanges independently. This is believed to be the first published case of *N. pseudofischeri* in an elderly patient. Comprehensive treatment included early removal of the PD catheter and the use of voriconazole (200 mg Vfend twice daily) for a period of 5 weeks. This case supports the need for more effective prophylaxis and treatment of non-*Candida* fungal infections in CAPD patients. Our conclusions from this case and a review of the literature are that infection with this fungus can cause substantial morbidity and is best treated with prompt catheter removal, aggressive antifungal therapy with voriconazole or amphotericin B, and vigilant observation for complications. Our report describes for what is believed to be the first time the administration of voriconazole to treat a *Neosartorya* peritonitis case.

Introduction

Peritonitis due to both intermittent and continuous ambulatory peritoneal dialysis (CAPD) remains the most common and serious complication of peritoneal dialysis (PD) (Piraino, 1998; Bibashi et al., 2003). Gram-positive bacteria are isolated in 55–80 % of cases (Gloor et al., 2003; Iqbal et al., 2008), and fungal isolates in up to 10 % of cases (Pimentel et al., 2005; Ram et al., 2008). In fungal peritonitis (FP), *Aspergillus* is rare and associated with a high mortality rate (De Hoog et al., 2000; Donnelly, 2002; Ram et al., 2008). FP is a potentially life-threatening complication of both intermittent and CAPD. Significant numbers of PD-associated cases of FP due to yeasts have been reported by several investigators (Chan et al., 1994; Garcia-Martos et al., 1991; Melez et al., 1995). *Candida* species account for more than 85 % of the cases, whereas filamentous FP is less frequent (Bibashi et al., 2003). Although filamentous fungi causing peritonitis are reported less frequently, they encompass a wide range of agents, from the classic, systemic fungi (Bibashi et al., 1993) to the zygomycetous species (Polo et al., 1989).

The genus *Neosartorya* (family Trichocomaceae) was established by Malloch & Cain (1972) to accommodate telemorphs of species belonging to the section *Fumigati*. This section now includes the anamorphs of 11 sexual *Neosartorya* species and 5 asexual *Aspergilli* (Varga et al., 2000; Hong et al., 2008). The species are thermophilic and closely related to *Aspergillus fumigatus*. *Neosartorya pseudofischeri* has whitish, fast-growing colonies at 37 °C and 45 °C, but not at 50 °C, whereas *A. fumigatus* grows at all these temperatures. It is very likely that infections by *Neosartorya* species are underdiagnosed in clinical practice because white aspergilli are often regarded as contaminants in the laboratory (Guarro et al., 2002). The morphology of such isolates should be carefully examined by using conventional cultures on malt extract or Czapek Dox agar (Difco), and sequence-based analysis should be used for species level identification.

Case report

A 60-year-old woman was on CAPD for end-stage renal insufficiency/failure due to renovascular disease and interstitial nephritis. Her past medical history included hypertension, hyperparathyroidism, and chronic obstructive pulmonary disease. She had commenced CAPD 13 months prior to this reported episode and performed peritoneal exchanges independently. During that period, there had been multiple episodes of suspected peritonitis, each treated empirically with 1 g cefazolin and 40 mg...
Neosartorya pseudofischeri peritonitis in a CAPD patient

Neosartorya pseudofischeri peritonitis in a CAPD patient

Methods

Identification of N. pseudofischeri (teleomorph of Aspergillus thermomutatus). Colony characteristics of strains were initially observed by culture on blood agar, and then by subculture on Sabouraud dextrose agar (Oxoid), and malt extract and Czapeck Dox agar (Difco Laboratories) plates at 25 °C, 30 °C and 45 °C for 2 to 3 days; culture at 50 °C revealed no growth. The culture on malt extract yielded abundant growth of ascomata at 25 °C. Morphological features of strains were observed by lactophenol cotton blue staining. Conidiophores with mature conidia of N. pseudofischeri morphologically resemble A. fumigatus; however, their conidia are whitish to greyish yellow instead of a deep bluish green. Electron microscopy scanning was not available; therefore, there was no characterization of the ascospores. However, the species could not be identified by its conidia formation. To identify the species, species-specific internal transcribed spacer region (ITS1/ITS2)-based molecular identification was performed (Fujita et al., 2001; Hinrikson et al., 2005). A similarity of 100% to the N. pseudofischeri sequence with GenBank accession number EF669966.1 (ITS1/2) was determined.

Etest. An Etest (AB Biodisk) for voriconazole was used for MIC determination on RPMI agar plates (Viva Diagnostika). The Etest strips were incubated at room temperature for 20 min due to the storage temperature of −20 °C. The Etest was performed according to the manufacturer’s instructions. Briefly, each RPMI plate was inoculated with 400 μl undiluted stock inoculum (ranging from 1 × 10⁶ to 5 × 10⁶ c.f.u. ml⁻¹) (Guinea et al., 2008). Plates were incubated at 35 °C in a humid atmosphere, and MICs were determined following incubation times of 24 and 48 h. The MIC with the Etest was defined as the lowest voriconazole concentration at which the border of the elliptical inhibition zone intercepted the scale on the Etest strip. For Aspergillus spp. and the remaining moulds no breakpoints for the new triazoles have been established. For Candida spp., the classification of the strains for the MIC breakpoint for voriconazole was as follows: susceptible, breakpoint of <1 μg ml⁻¹; susceptible dose dependent, 2 μg ml⁻¹; resistant, >4 μg ml⁻¹ (Pfaller et al., 2006). For our isolate of N. pseudofischeri the MIC for

Fig. 1. Patient’s abdominal CT scan on eighth day after first examination (after removal of the catheter); the white arrow indicates the oedematous inflammation of the peritoneum (peritonitis) due to N. pseudofischeri.
voriconazole was 1.0 (0.5–1.0) µg ml⁻¹. Where the elliptical inhibition zone intercepted the scale on the Etest strip between two MIC values, the MIC end point was taken as the higher value.

The determination of other antifungal MICs was carried out with the commercially available ATB fungus test (bioMérieux). The MICs obtained were >64 µg ml⁻¹ for fluconazole, >128 µg ml⁻¹ for fluconazole, 0.500 µg ml⁻¹ for amphotericin B and 1.0 µg ml⁻¹ for itraconazole.

**Discussion**

In general, FP has a prevalence of 0.1 to 10%, with *Candida albicans* being the predominating aetiological agent (Bibashi et al., 2003; Ram et al., 2008). However, FP caused by filamentous fungi is much less common (Bibashi et al., 2003). Fungi can enter the peritoneal cavity through a catheter intraluminally or periluminally, but in a few cases a vaginal route of infection has also been observed (Stuck et al., 1986). FP is associated with a mortality rate of 5 to 25% (Bibashi et al., 1993). Risk factors for FP include recent exposure to antibiotics, immunosuppressive therapy, recent bacterial peritonitis and the presence of bowel perforation (Eisenberg et al., 1986; Ujhelyi et al., 1990).

The case we report is believed to be the first case of *Neosartorya* peritonitis in an elderly patient (Matsumoto et al., 1993; Sridhar et al., 1990; Carpenter et al., 1989; Sridhar et al., 1990; Perez-Fontan et al., 1991; Bibashi et al., 1993; Tanis et al., 1995; Miles & Barth, 1995; Geiss, 1995; Park et al., 1996). Risk factors included recent antibiotic therapy, steroid therapy, recurrent peritonitis, an immunosuppressed state and hospitalization. A high mortality for FP has been reported, generally in cases where diagnosis was delayed and the catheter not removed (Tsai et al., 1991; Miles & Barth, 1995). Over the last four decades among our 19 selected FP cases (Table 1) in 3 cases with an outcome of death the catheter was not removed, 2 patients were treated with amphotericin and the third patient had no antifungal treatment. Only voriconazole treatment was administered in our peritonitis patient, although Balajee et al. (2005) reported that three isolates of *N. pseudofischeri* had higher MICs to voriconazole in vitro compared to *A. fumigatus*. In previous cases other antifungals were given, preferentially amphotericin B. Another *N. pseudofischeri* isolate from a different case in our clinic (data not shown) also presented a low MIC (<0.5 µg ml⁻¹) to voriconazole as in the case presented here.

Diagnosis can be quite difficult, since the symptoms are identical to bacterial peritonitis. A Gram stain can occasionally reveal the typical hyphae of *Aspergillus*. Otherwise, a positive culture result must be obtained, and preferably a positive result from repeated cultures, since *Aspergillus* can occur as a laboratory contaminant (Geiss, 1995). In most cases, positive cultures are obtained after 5 and 10 days. However, since delayed treatment has an increased mortality, one should not wait for the results of repeated cultures; intravenous treatment with vorico-

**Table 1. A selection of reported cases of Aspergillus and Neosartorya peritonitis**

<table>
<thead>
<tr>
<th>Age of patient (years)</th>
<th>Sex</th>
<th>Fungal species</th>
<th>Catheter removal</th>
<th>Antimycotic</th>
<th>Outcome</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>22 F A. fumigatus</td>
<td>No</td>
<td>None</td>
<td>Amphotericin B (i.v., i.p.)</td>
<td>Death</td>
<td>Ross et al. (1968)</td>
<td></td>
</tr>
<tr>
<td>61 F A. fumigatus</td>
<td>No</td>
<td>None</td>
<td>Amphotericin B (i.v.)</td>
<td>Death</td>
<td>Arfania et al. (1981)</td>
<td></td>
</tr>
<tr>
<td>64 M A. flavus</td>
<td>No</td>
<td>None</td>
<td>Amphotericin B (i.v.)</td>
<td>Death</td>
<td>Carpenter et al. (1982)</td>
<td></td>
</tr>
<tr>
<td>40 M A. niger</td>
<td>Yes</td>
<td>Amphotericin B</td>
<td>Amphotericin B (i.v.)</td>
<td>Death</td>
<td>Rodriguez-Tudela et al. (1988)</td>
<td></td>
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<tr>
<td>66 M A. niger</td>
<td>Yes</td>
<td>Amphotericin B</td>
<td>Amphotericin B (i.v.)</td>
<td>CAPD</td>
<td>Prewitt et al. (1989)</td>
<td></td>
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<tr>
<td>49 F A. niger</td>
<td>Yes</td>
<td>Amphotericin B</td>
<td>Amphotericin B (i.v.)</td>
<td>HD</td>
<td>Sridhar et al. (1990)</td>
<td></td>
</tr>
<tr>
<td>68 F A. fumigatus</td>
<td>Yes</td>
<td>Amphotericin B</td>
<td>Amphotericin B (i.v.)</td>
<td>HD</td>
<td>Stein et al. (1991)</td>
<td></td>
</tr>
<tr>
<td>69 M Unidentified</td>
<td>Yes</td>
<td>Amphotericin B</td>
<td>Amphotericin B (i.v., i.p.)</td>
<td>CAPD</td>
<td>Perez-Fontan et al. (1991)</td>
<td></td>
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<tr>
<td>35 F A. niger</td>
<td>Yes</td>
<td>Amphotericin B</td>
<td>Amphotericin B (i.v.)</td>
<td>CAPD</td>
<td>Bibashi et al. (1993)</td>
<td></td>
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<tr>
<td>68 M A. fumigatus</td>
<td>Yes</td>
<td>Amphotericin B</td>
<td>Amphotericin B (i.v.)</td>
<td>CAPD</td>
<td>Tanis et al. (1995)</td>
<td></td>
</tr>
<tr>
<td>61 M A. fumigatus</td>
<td>Yes</td>
<td>Amphotericin B</td>
<td>Amphotericin B (i.v.)</td>
<td>Death</td>
<td>Tsoufakis et al. (1995)</td>
<td></td>
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<tr>
<td>37 M A. niger</td>
<td>Yes</td>
<td>Amphotericin B</td>
<td>Amphotericin B (i.v.)</td>
<td>HD</td>
<td>Kitiyakara et al. (1996)</td>
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<tr>
<td>60 F A. fumigatus</td>
<td>Yes</td>
<td>Ketocanazole</td>
<td>Ketocanazole</td>
<td>HD</td>
<td>Bren (1998)</td>
<td></td>
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<tr>
<td>64 M A. fumigatus</td>
<td>Yes</td>
<td>Amphotericin B</td>
<td>Amphotericin B (i.v.)</td>
<td>Death</td>
<td>Bren (1998)</td>
<td></td>
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<tr>
<td>30 F Aspergillus sp.</td>
<td>Yes</td>
<td>Amphotericin B</td>
<td>Amphotericin B (i.v.)</td>
<td>Death</td>
<td>Bren (1998)</td>
<td></td>
</tr>
<tr>
<td>52 F A. niger</td>
<td>Yes</td>
<td>Amphotericin B</td>
<td>Amphotericin B (i.v.)</td>
<td>HD</td>
<td>Basok et al. (2000)</td>
<td></td>
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<tr>
<td>8  F N. pseudofischeri</td>
<td>Yes</td>
<td>Liposomal amphotericin B</td>
<td>Liposomal amphotericin B (i.v.)</td>
<td>HD</td>
<td>Matsumoto et al. (2002)</td>
<td></td>
</tr>
<tr>
<td>45 F A. fumigatus</td>
<td>Yes</td>
<td>Amphotericin B</td>
<td>Amphotericin B (i.v.)</td>
<td>CAPD</td>
<td>Schattner et al. (2006)</td>
<td></td>
</tr>
<tr>
<td>60 F N. pseudofischeri</td>
<td>Yes</td>
<td>Voriconazole</td>
<td>Voriconazole (i.v.)</td>
<td>HD</td>
<td>This study</td>
<td></td>
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</table>
nazole or amphotericin B should be administered immediately. Susceptibility testing revealed that amphotericin B is also an antifungal agent to which the organism had a low MIC of 0.5 μg ml⁻¹. On the other hand, *N. pseudofischeri* had a high MIC for fluconazole and flucytosine. With respect to the removal of the catheter, there is general agreement in the literature that this is mandatory and should be performed as soon as possible (Stein et al., 1991; Perez-Fontan et al., 1991; Tanis et al., 1995; Miles & Barth, 1995; Park et al., 1996).

In summary, we conclude that *Neosartorya* peritonitis is a severe form of peritonitis in CAPD patients. The need for more effective treatment and prophylaxis for fungal infections in CAPD is obvious; which means in cases where bacterial culture of peritoneal fluid is negative, this may indicate the possibility of fungal infection. If a positive fungal culture is obtained, antymycotic therapy should be started immediately, and the Tenckhoff catheter removed as quickly as possible, preferably within 24 h of the diagnosis, as it is mostly impossible to eradicate the infection without removing the catheter. In addition to blood agar, Sabouraud dextrose agar for *Aspergillus* species and *Candida* chromogenic agar should be used for the initial culture. A recent bacterial infection treated with antibiotics could be a predisposing factor for FP. An earlier CT scan might help raise suspicion of a fungal inflammation being present and indicate the need for administration of antymycotics as well as antibiotics. The prompt diagnosis of FP and the early institution of therapy (e.g. amphotericin B) decrease the rates of morbidity and mortality. As in our case, the removal of the catheter alone did not resolve the peritoneal inflammation within a few days (up to 1 week), which would support the administration of antymycotic therapy simultaneously to catheter removal.

**References**


