A probiotic can be defined as a live, non-pathogenic microbial supplement that exerts a positive influence on the health or physiology of the host [1, 2]. Probiotics consist of either bacteria, especially lactic acid bacteria, or yeast. Probiotics have mainly been used for gastrointestinal and vaginal diseases [3].

The effects of probiotics are thought to be related to direct enzymatic effects or to a modulation of the endogenous flora or of the immune system [4]. Efficacy of probiotics in persons with enzymatic defects is now well accepted. Lactase from lactic bacteria, or yeast. Probiotics have mainly been used for gastrointestinal and vaginal diseases [3].

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disease, suggesting an immunomodulatory effect for probiotics [1, 10].

Probiotics are becoming increasingly available as dietary supplements, are largely used in the diary food industry, and, in continental Europe, are regarded as medicines. S. boulardii (Ultra-Levure [Biocodex], Ultralevura [Bristol-Myers Squibb], and Codex [Zambon Farmaceutici]) is registered in several European countries and has been proposed for the treatment of several types of diarrhea, either as prophylaxis against antibiotic-associated diarrhea or as a treatment for diarrhea in adults and children infected with C. difficile, for diarrhea in HIV-infected patients, and for acute diarrhea in children and adults. Contraindications listed for Ultra-Levure in the French labeling are hypersensitivity or intolerance to one of the constituents and presence of a central venous catheter. The latter contraindication derives from cases of S. boulardii fungemia predominantly reported in patients with central venous lines in place [11, 12]. The origin of the fungemia is thought to be either a digestive tract translocation or a contamination of the central venous line by the colonized hands of health care workers after the probiotic capsules have been opened [11].

Many cases of fungemia due to S. cerevisiae (well known as “baker’s yeast” or “brewer’s yeast”) or S. boulardii have been reported. Whether S. boulardii is different from S. cerevisiae was a matter of debate [13]; this debate is now over. Despite certain phenotypic differences, genotypic and proteomic analyses have definitively recognized S. boulardii as a member of the species S. cerevisiae [14, 15]. S. boulardii strains as obtained in France and Italy from commercially available products exert intermediate virulence, compared with virulent and avirulent strains of S. cerevisiae [16]. In several cases, the fungemia has been related to the use of the probiotic agent in the patient immediately prior to or concomitantly with the fungemia [11, 16].

In this issue, Munoz et al. [17] add 3 new cases of S. cerevisiae fungemia to the list. The originality of this publication is the demonstration that the strains were identical in all 3 patients and, furthermore, that they were identical to the strain given orally as Ultralevura to these patients before the onset of fungemia. The authors report an outbreak of 3 cases of S. cerevisiae fungemia over a 2-week period in an intensive care unit. The reason for the prescription of the probiotic was C. difficile-associated diarrhea. All 3 patients received S. boulardii from opened capsules of Ultralevura administered via nasogastric tubes. Probiotic treatment was started 7 or 8 days before the fungemia occurred. The authors reviewed the records of the 41 patients without S. cerevisiae fungemia who had been hospitalized in this intensive care unit during the same period. Only 2 of the 41 control patients had received Ultralevura, and none of the 14 patients admitted to the unit when the outbreak of infection occurred were recognized to have had positive surveillance culture results at entry into the unit. Discontinuation of the Ultralevura therapy in the unit stopped the outbreak. The authors demonstrated, by molecular typing, that the strains isolated in the 3 cases were similar to the strains cultured from an Ultralevura capsule.

In addition to these epidemiological data, Munoz et al. [17] extensively reviewed the literature to identify previously reported cases of S. cerevisiae or S. boulardii fungemia. The use of the probiotics was reported in nearly one-half of the 60 patients (including the 3 patients they describe), and almost all of the patients had a central venous catheter in place. The overall mortality was 28%.

This review confirms that the most important risk factor for S. cerevisiae fungemia is the use of probiotics. This raises the question of the risk-benefit ratio of these agents in critically ill or immunocompromised patients who are likely to develop an infection after exposure to high amounts of a pathogen with a low virulence. S. boulardii should certainly be contraindicated for patients of fragile health, as well as for patients with a central venous catheter in place. Whether this probiotic still has a place in less severe situations needs to be reassessed.

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