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Preliminary Communication

The Provox™ voice prosthesis and *Candida albicans* growth: a preliminary report of clinical, mycological and scanning electron microscopic assessment

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Abstract

Provox™ voice prostheses are low-resistance speech valves available since 1990 for post-laryngectomy voice rehabilitation. *Candida spp.* mycelial growth has always been a major problem in all prosthetic valves causing leakage and limiting valve life. We found that the Provox™ new valves were not exempt from the old problem. We performed a preliminary clinical, mycological and scanning electron microscopic assessment of *Candida spp.* growth on these valves. In contrast to studies done with other valves we found that the *Candida* mycelium on these new valves was a surface colony rather than growing into the valve substance, thus it might be feasible to control the mycelial growth by either mechanical cleansing or by using topical anti-fungal agents.

Key words: Larynx, artificial; *Candida*; Microscopy, electron, scanning

Introduction

There are several voice prostheses available for successful rehabilitation of laryngectomy patients. Various factors have been taken into consideration in designing these valves. The cost of the valve is a critical factor and is related to the longevity of the prosthesis. *Candida* mycelial growth on the valve causes rapid deterioration of the valve function (Mahieu *et al.*, 1986 a), leading to its frequent change and therefore increasing costs. The Provox™ valves are made of silicone and were introduced in 1990 (Hilgers and Schouwenburg, 1990). These valves produced effortless speech but the cost was twice that of the Blom–Singer prosthesis (Singer and Blom 1980). Again *Candida* mycelial growth was the limiting factor decreasing the valve life.

We decided to find out whether the *Candida* mycelium on these valves grew into the valve substance or was only a surface colony. A clinical, mycological and electron microscopic assessment of the valves showing *Candida* mycelial growth was carried out. As opposed to studies on other valves (Mahieu *et al.*, 1986 a) we found that the *Candida* mycelium on these valves was only a surface colony which was consequently amenable to mechanical cleansing thus prolonging the valve life.

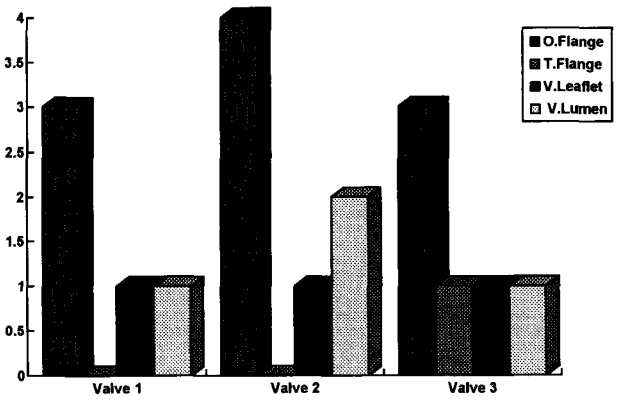

FIG. 1

Bar chart showing the density of *Candida albicans* growth at various valve sites.

Patients, materials and methods

We made a clinical, mycological and scanning electron microscopic assessment of the Provox™ valves colonized by *Candida albicans* from three patients who needed a valve change. The valves were examined and photographed *in situ* before removal. The oesophageal and tracheal flanges were examined using a flexible endoscope and the valve lumen and leaflet were examined using a 2.7 mm rigid endoscope.

The *Candida* mycelial growth densities in various valve sites were compared using a scoring system as follows: the oesophageal and tracheal flanges were arbitrarily divided into four quadrants and they were given a score from 0–4 ranging from the absence to the presence of *Candida* in all four quadrants; the leaflet was divided into tracheal and oesophageal sides and given a score of 0 for the absence of *Candida* to 1 for the involvement of the oesophageal side and 2 for the involvement of both sides; the valve lumen was given a score of 0 for absence of *Candida* to 1 for involvement of less than half of the lumen and 2 for the involvement of the entire lumen. These findings were confirmed after removal and recorded photographically. Once clinical and endoscopic assessments of these valves were made they were transported, in a fungal medium, to the mycology laboratory where the colonized valves were sectioned and analysed under a scanning electron microscope.

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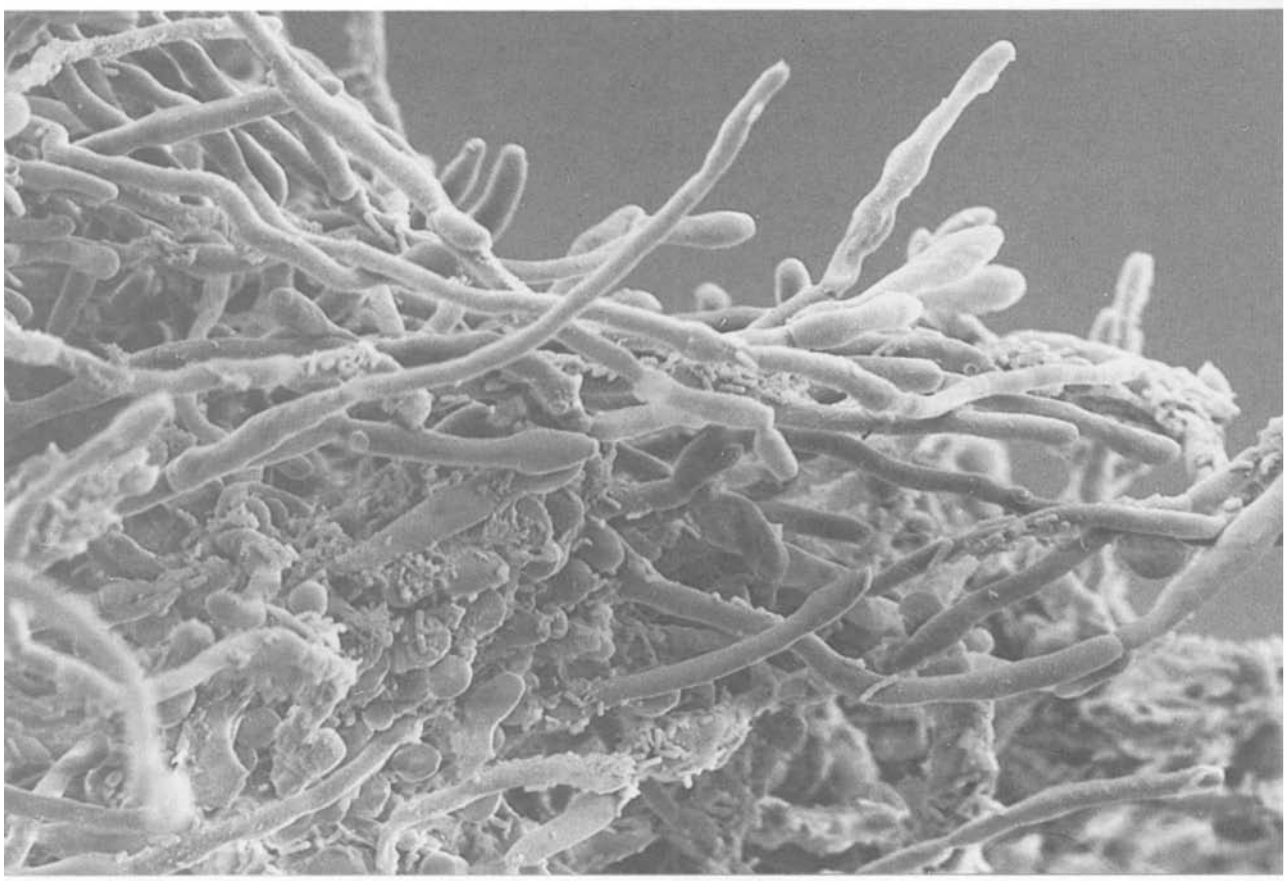

Fig. 2

Showing the blastoconodial and pseudohyphal morphology of *Candida albicans*.

Results

The density scores for *Candida albicans* mycelial growth affecting different valve sites are shown in the bar chart (Figure 1).

The oesophageal flanges were the commonest valve site to be involved (Figure 1). Scanning electron microscopy of these valves confirmed the presence of *Candida* mycelium shown by the typical blastoconidial and pseudohyphal morphology of the yeast (Figure 2). No obvious degeneration of the valve surface was seen suggesting that the valve matrix is resistant to hydrolytic enzymes which are readily released by the yeast during its growth cycle. The *Candida albicans* mycelium was found to be only a surface colony rather than growing into the valve substance (Figure 3).

Discussion

The growth of a *Candida* mycelium on prosthetic valves is a persistent major problem interfering with the valve function and reducing the valve life which consequently increases costs. We found that Provox™ valves were no exception to the problem. Patients with head and neck malignancies who have been irradiated have high concentrations of *Candida spp.* in the oropharyngeal cavity (Martin *et al.*, 1981; Mahieu *et al.*, 1986 b). In all our patients who needed a valve change we found dense deposits of *Candida albicans* particularly affecting the oesophageal flange. The characteristic clinical appearance of yellowish, dirty, deposits of *Candida albicans* were confirmed by scanning electron microscopy (Figure 2).

The early stage of *Candida* colonization on prosthetic surfaces involves a specific interaction between the yeast cells and the silicone rubber polymers. *Candida spp.* seem to have a preferential adhesion to silicone polymers by hydrophobic interaction (Managi *et al.*, 1984). It is apparent that *Candida spp.* cells adhere well to the materials used in voice prostheses. *In vitro*, *Candida albicans* has been shown to adhere well to fibrin-platelet matrices and to fibronectin (Rotrosen *et al.*, 1986). Both of these components may be exposed on prosthetic surfaces. Furthermore *Candida albicans* cells cultured in high carbohydrate-containing environments adhere more easily to various host surfaces (Rotrosen *et al.*, 1986).

The most important finding in our study, when viewed under scanning electron microscopy, was that, the *Candida* mycelial growth was a surface colony (Figure 3) rather than growing into the valve substance. This was in contrast to other studies carried out in the past using other valves where *Candida* hyphae were found to be growing into the valve substance (Mahieu *et al.*, 1986 a). The *Candida* mycelium which is adherent to the valve should be more amenable to mechanical cleansing than if it is growing into the valve substance. Thus our study suggests a possibility for controlling and removing *Candida* mycelium from these Provox™ valves by mechanical cleansing thus aiming to prolong the valve life and to cut costs. Prospective trials are already under way in our unit. Research work aimed at developing a biocompatible material which is resistant to the adherence of *Candida spp.* would be prudent.

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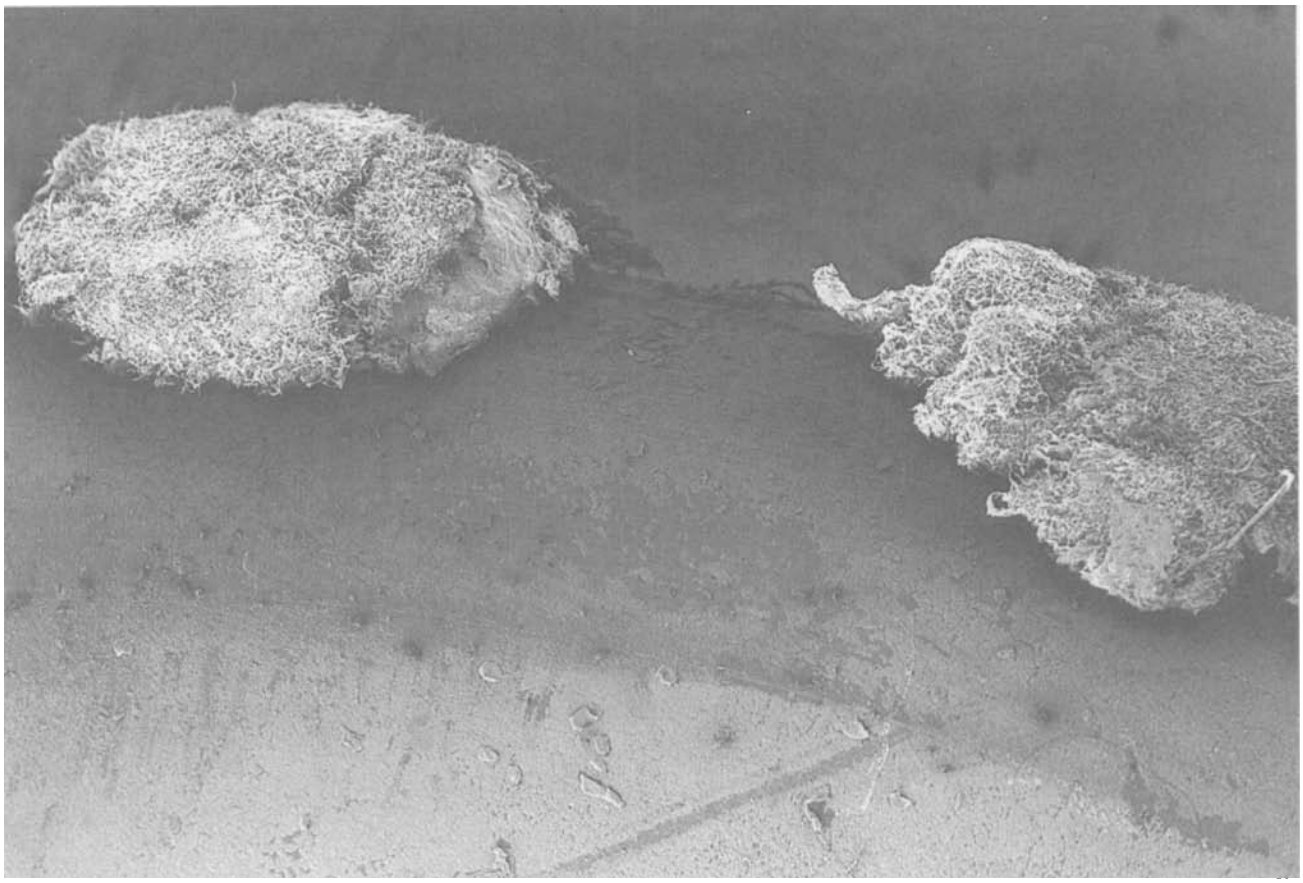

Fig. 3

Showing the surface growth of *Candida albicans* on Provox™ valves.

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