A case series of medically managed *Candida parapsilosis* complex prosthetic valve endocarditis

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**Abstract**

**Background:** In recent years, *Candida parapsilosis* is recognized as a species complex and is composed of *Candida parapsilosis* sensu stricto, *Candida orthopsilosis* and *Candida metapsilosis*. *Candida parapsilosis* complex prosthetic valve endocarditis (PVE) is rare and the survival rate is still low despite of optimal therapeutic strategies. In our report, it is novel to report cases as *Candida parapsilosis* complex PVE at species and identify *Candida parapsilosis* using MALDI-TOF MS.

**Case presentation**

A series of 4 cases of *Candida parapsilosis* complex PVE from our institution was reported. Three were infected by *Candida parapsilosis* sensu stricto and one was infected by *Candida metapsilosis*. The condition of two cases got better and the other died.

**Conclusions:** More attention should be paid to *Candida parapsilosis* complex PVE and early diagnosis and prompt antibiotic therapy may play a role in the treatment for *Candida parapsilosis* complex PVE. It is recommended to identify *Candida parapsilosis* complex at species level and MALDI-TOF MS as an easy, fast and efficient identification method is worth promoting in clinical microbiology.

**Keywords:** Prosthetic valve endocarditis, *Candida parapsilosis* complex, Combination antifungal therapy, Matrix-assisted laser desorption ionization-time of flight mass spectrometry

**Introduction**

Prosthetic valve endocarditis (PVE) is a complication of cardiac valve replacement and is related with a high mortality [1]. What’s more, the incidence of PVE is increasing and it accounts for 20–30% of infective endocarditis episodes [2]. Generally, typical microorganisms causing PVE were mainly bacteria, especially *Enterococci* and *Staphylococcus aureus* [3]. Fungal endocarditis (FE) is a rare and fatal form of infectious endocarditis [4]. *Candida* and *Aspergillus* species are two of the most common etiologic fungi for FE. Among *Candida* endocarditis, *Candida albicans* is the main cause of FE and *Candida parapsilosis* is the most common non-albicans species responsible for FE [5]. In the last years, *Candida parapsilosis* is recognized as a species complex and is composed of *Candida parapsilosis* sensu stricto, *Candida orthopsilosis* and *Candida metapsilosis*, which are unique but related [6]. The *Candida parapsilosis* complex is opportunistic fungal pathogen responsible for many human nosocomial infections. *Candida parapsilosis* complex PVE is rare and the survival rate is still low despite of optimal therapeutic strategies [7]. However, the literature on *Candida parapsilosis* complex PVE is limited. What’s more, the previous studies did not identify *Candida parapsilosis* complex at
species level. More information about Candida parapsilosis complex PVE at species level and the management of it is needed. Here we present a case series of Candida parapsilosis complex PVE in patients with aortic valve replacement (AVR) or mitral valve replacement (MVR) from the First Affiliated Hospital of Sun Yat-Sen University, providing more information about Candida parapsilosis complex PVE at species level and reference on the treatment of it. All patients received detailed counseling and informed written consent was obtained from each participant.

**Case description**

**Case report 1**

The first patient was a 55-year-old man who had a history of smoking for more than 10 years. The patient underwent mitral valve replacement in 2012. On 24th of December 2017, he was admitted into the First Affiliated Hospital of Sun Yat-Sen University because of aggravated shortness of breath for one month and edema of both lower extremities for 3 days. The initial blood count showed hemoglobin level of 100 g/L, white blood cell (WBC) count of 5.28×10^9 cells/L (46.6% neutrophils, 36.2% lymphocytes), raised erythrocyte sedimentation rate (ESR) (74 mm/h) and C-reactive protein (CRP) (10.60 mg/L). The procalcitonin (PCT), troponin T and N-terminal prohormone of brain natriuretic peptide (NT-proBNP) all increased (Table S1). Bed-side chest radiograph showed inflammation of both lungs and enlarged heart shadow in the supine position. Transthoracic echocardiography (TTE) showed two vegetations on prosthetic mitral valve and accelerated velocity of the prosthetic mitral valve (140 cm/s) The effective orifice area was 1.8 cm^2 (Fig. 1), indicating infectious endocarditis after MVR. TTE also found moderate tricuspid regurgitation and mild pulmonary artery hypertension. The left ventricular ejection fraction (LVEF) was approximately normal (56%) and the diastolic function was reduced. The electrocardiograph (ECG) indicated atrial flutter (2–3: 1 conduction) with rapid ventricular rate. The (1,3)-β-D glucan was 93.99 pg/mL and Candida parapsilosis sensu stricto was identified in the blood culture by Matrix-assisted laser desorption ionization-time of flight mass spectrometry (MALDI TOF–MS) (bioMerieux, France) (Flucytosine minimal inhibitory concentration (MIC) 4 ug/mL, amphotericin B MIC 0.5 ug/mL, voriconazole MIC 0.06 µg/mL, itraconazole MIC 0.125 µg/mL, fluconazole MIC 1 µg/mL). The cutoff values for antifungal susceptibility testing were on the basis of CLSI M59 and CLSI M60 [8, 9]. Repeat blood cultures continued to grow Candida parapsilosis sensu stricto. The patient was initiated on vancomycin 1 g iv three times a day and voriconazole 200 mg iv twice a day after admission. Then, combination antifungal therapy with vancomycin 1 g iv three times a day and caspofungin iv 50 mg once a day was initiated on Dec 29. Because of high vancomycin blood concentration, the therapy changed to vancomycin 1 g iv twice a day and caspofungin 50 mg iv once a day on Dec 30 and lasted until discharging. Besides, ceftriaxone sodium was administrated from Dec 30 of 2017 to Jan 3 of 2018 to fight lung infections. After a series of anti-infective treatment, the patient’s condition improved. However, the blood cultures continued to grow Candida parapsilosis sensu stricto and the patient refused the surgical treatment despite of the indications of operation. The patient went back to local hospital and was recommended to continue the combination antifungal therapy according to the drug sensitivity.

![Fig. 1](image) The Candida parapsilosis complex prosthetic valve endocarditis of case 1. a Echocardiography showed a vegetation on the artificial mitral valve. b The Color Doppler showed increased flow rate at the prosthetic mitral valve orifice and tricuspid regurgitation (moderate)
Case report 2
The second patient was a 71-year-old man with a history of hypertension for 3 years and smoking for 30 years. He was admitted into the First Affiliated Hospital of Sun Yat-Sen University on April 26 of 2019 for repeated chest tightness and palpitations for more than 10 years, aggravating by 1 year. TTE showed that posterior mitral valve tendon cord was ruptured, which resulted in posterior mitral valve prolapse and severe mitral valve regurgitation. At the same time, TEE found mild aortic valve stenosis and mild-moderate regurgitation, anterior tricuspid valve prolapse and medium regurgitation, severe pulmonary artery hypertension. The aorta root, the left atrium and left ventricle were significantly enlarged. The right atrium was slightly larger and the left ventricular ejection fraction (LVEF) was about 70%. On May 5, the patient underwent aortic valve and mitral valve bioprosthesis replacement, tricuspid valvuloplasty and temporary cardiac pacemaker implantation. The patient was given cefperazone-sulbactam 3 g iv three times a day from May 5 to May 17, cilastatin sodium/imipenem iv 1 g once a day from May 20 to May 28 and cefperazone-sulbactam 3 g iv three times a day from May 28 to May 31. On May 24, the blood culture grew yeast-like fungus and the yeast-like fungus was identified Candida parapsilosis sensu stricto by MALDI TOF-MS (bioMérieux, France) (Flucytosine MIC 4 µg/mL, amphotericin B MIC 0.5 µg/mL, voriconazole MIC 0.06 µg/mL, itraconazole MIC 0.125 µg/mL, fluconazole MIC 1 µg/mL). Then the patient was administered caspofungin (50 mg iv once a day) to fight fungal infection. On June 13, the blood culture still grew Candida parapsilosis sensu stricto and the patient continued to use caspofungin (50 mg iv once a day). On June 24, the patient had a fever of 39.2°C and the blood culture still Candida parapsilosis sensu stricto. Then the patient was given voriconazole (200 mg oral twice a day) instead of caspofungin. The blood culture became negative after 1 month using voriconazole. The patient continued to use voriconazole (200 mg oral once a day) for 2 weeks after discharging.

Six months later, the patient was readmitted into the First Affiliated Hospital of Sun Yat-Sen University on November 4 due to fever for 20 days and shortness of breath for 3 days after activity. The initial blood count showed WBC count of 3.76 × 10⁹ cells/L (78.8% neutrophils, 10.3% lymphocytes). The (1,3) -β-D glucan was 144.85 pg/mL and the blood culture grew Candida parapsilosis sensu stricto which was identified by MALDI TOF-MS (bioMérieux, France) (Flucytosine MIC 4 µg/mL, amphotericin B MIC 0.5 µg/mL, voriconazole MIC 0.06 µg/mL, itraconazole MIC 0.125 µg/mL, fluconazole MIC 1 µg/mL). Then the patient was administrated voriconazole 200 mg iv twice a day from November 4 to 21, caspofungin 50 mg iv twice a day from November 21 to December 4 and amphotericin B 1 mg iv once a day from November 26 to December 4. Besides, the patient was administrated piperacillin-tazobactam 4.5 g iv three times a day from Nov 4 to Nov 6, vancomycin 0.5 g iv once a day from Nov 17 to Nov 21 and cilastatin sodium/imipenem iv 1 g once a day from Nov 21 to Dec 4. The patient’s body temperature was relieved, fluctuating around 37.5°C. Then the patient was discharged and recommended antifungal treatment in local hospital with cilastatin sodium/imipenem iv injection 1000 mg three times a day, caspofungin 50 mg once a day and amphotericin B 30 mg once a day.

Case report 3
The third patient was a 70-year-old man who underwent aortic valve replacement in 2011 and was admitted in the First Affiliated Hospital of Sun Yat-Sen University on November 22 of 2015 due to repeated fever for more than 50 days and acute bloating for 12 days. The initial blood count showed WBC count of 2.95 × 10⁹ cells/L (64.8% neutrophils, 22.7% lymphocytes). The PCT, troponin T, NT-proBNP and the (1,3)-β-D glucan all increased. TTE showed a hypoechoic vegetation was formed on prosthetic aortic valve and the size of the vegetation was about 17.8 × 8.0 mm. Besides, enlarged left atrium and left ventricle, mild-moderate mitral valve regurgitation, moderate tricuspid regurgitation, moderate pulmonary artery hypertension was found. The LVEF was about 74% and diastolic function of left ventricular was reduced (grade I) (Fig. 3). Abdominal examination showed gas accumulation in the intestine, indicating intestinal obstruction. The patient presented septic shock, poor heart function and arrhythmia, incomplete intestinal obstruction and water and electrolyte balance disorders. The blood culture grew Candida parapsilosis sensu stricto (Flucytosine MIC 4 µg/mL, amphotericin B MIC 0.5 µg/mL, voriconazole MIC 0.06 µg/mL, itraconazole MIC 0.125 µg/mL, fluconazole MIC 1 µg/mL). The patient was given anti-infection and anti-shock treatment. The patient was administrated flucloxanole 100 mg iv once a day from November 23 to November 27 and voriconazole 200 mg iv twice a day. Besides, the patient was also given cefperazone-sulbactam 3 g iv three times a day from November 22 to December 4. Fourteen days after a series of treatments, the patient presented cardiac rhythm of 130 beats/min, atrial fibrillation rhythm, blood pressure of 100/60 mmHg, maximum temperature 40°C,
30 breaths/min, SPO2 84–90% and SPO2% 90–94 under mask oxygen inhalation. The patient finally died in spite of a series of emergency measures.

**Case report 4**

The fourth patient was a 64 year-old man with a history of hepatitis B and underwent aortic bioprosthesis valve replacement and mitral bioprosthesis valve replacement in 2016. Three years later, the patient was readmitted into the First Affiliated Hospital of Sun Yat-Sen University on November 7 of 2019 because of repeated fever for nearly 2 months without incentive. The initial blood count showed WBC count of 3.91 × 10⁹ cells/L (73.7% neutrophils, 18.8% lymphocytes). The PCT, troponin T and NT-proBNP were 0.61 ng/mL, 0.059 ng/mL and 10,864 pg/mL respectively, which were all increased. Bedside echocardiography showed the prosthetic mitral valve functioned normally, but there was a vegetation which was nearly 19 × 10 mm. The blood culture grew *Candida metapsilosis* which was identified by MALDI TOF–MS (bioMerieux, France) (Flucytosine MIC 4 ug/mL, amphotericin B MIC 0.5 ug/mL, voriconazole MIC 0.06 ug/mL, itraconazole MIC 0.125 ug/mL, fluconazole MIC 2 ug/mL) (Table 1 and Additional file 1: Table S1). Then the patient was administrated fluconazole 100 mg iv once a day from November 7 to 9 and caspofungin 50 mg iv once a day from November 9 to 10, as well as cefperazone-sulbactam 3 g iv three times a day for four days. On the fourth day of admission, the patient had a ventricular fibrillation suddenly. After a series of rescue measures, the patient’s condition didn’t improve and died.

**Discussion**

With the increasing infection rate of *Candida*, *Candida* endocarditis especially *Candida parapsilosis* complex endocarditis gains more and more attention because of its high mortality and morbidity [10, 11]. In recent years, with the widespread application of life support systems, *Candida parapsilosis* complex has become the second most common pathogen of candidiasis. *Candida parapsilosis* complex is the normal flora colonizing on gastrointestinal tract, skin and oropharynx. The general incentives for *Candida parapsilosis* complex contain the prosthetic valves (57.4%), IV drug use (IVDU; 20%), IV parenteral nutrition (6.9%), abdominal surgery (6.9%), immunosuppression (6.4%), using

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**Table 1 Clinical characteristics of the patients**

|                        | Case 1 | Case 2 | Case 3 | Case 4 |
|------------------------|--------|--------|--------|--------|
| Age(years)             | 55     | 71     | 70     | 64     |
| Gender                 | Male   | Male   | Male   | Male   |
| Type of surgery        | Mitral valve replacement | Aortic and mitral valve replacement | Aortic valve replacement | Aortic and mitral valve replacement |
| Type of valve replacement | Medtronic Hanko II 27# (mitral valve); Medtronic Hanko II 21# (aortic valve) | / | / | Edward 25# (mitral valve); Edward 21# (aortic valve) |
| Possible predisposing factor for infective endocarditis | Smoking | Fungemia Hypertension Smoking | / | Hepatitis B |
| Symptoms on admission  | Aggravated shortness of breath for one month and edema of both lower extremities for 3 days | Fever for 20 days and shortness of breath for 3 days after activity | Repeated fever for more than 50 days and acute bloating for 12 days | Repeated fever for nearly 2 months |
| Infection site         | Mitral valve | Mitral valve | Aortic valve | Mitral valve |
| Time post implantation | Five years | Six months | Four years | Three years |
| Pathogen (isolated from blood) | *Candida parapsilosis* sensu stricto | *Candida parapsilosis* sensu stricto | *Candida parapsilosis* sensu stricto | *Candida metapsilosis* |
| MIC (ug/mL)            | 4      | 4      | 4      | 4      |
| 5-Flucytosine          | 0.5    | 0.5    | 0.5    | 0.5    |
| Amphotericin B         | 0.06   | 0.06   | 0.06   | 0.06   |
| Voriconazole           | 0.125  | 0.125  | 0.125  | 0.125  |
| Itraconazole           | 1      | 1      | 1      | 2      |
| Fluconazole            | Voriconazole, caspofungin | Voriconazole, caspofungin, amphotericin B | Voriconazole, fluconazole | Fluconazole, caspofungin |
| Choice of antifungal drugs | Successful medical therapy | Successful medical therapy | Death | Death |

*MIC minimal inhibitory concentration*
broad-spectrum antibiotics (5.6%) and previous valvular disease (4.8%) [12]. Candida parapsilosis strains are heterogeneous. Recently, Candida parapsilosis is recognized as a species complex. Tavanti et al. [13] suggested to divide Candida parapsilosis group into three species named Candida parapsilosis sensu stricto, Candida orthopsilosis and Candida metapsilosis. The biological phenotypic characteristics of the three species of fungi are basically the same but they belong to different genotypes. Conventional fungal identification
methods cannot distinguish between them. They can only be distinguished by Matrix-assisted laser desorption ionization-time of flight mass spectrometry (MALDI TOF–MS) or molecular biology method. In the previous reports (Table 2) [14–24], the authors all did not distinguish the three species of Candida parapsilosis and just described the cases as Candida parapsilosis PVE. However, in our report, we distinguish the three species of Candida parapsilosis. In our study, there were three cases of Candida parapsilosis sensu stricto and one case of Candida metapsilosis. Species of Candida parapsilosis complex are important pathogens of nosocomial infections and the molecular identification of Candida parapsilosis complex at the species level is essential for optimal treatment and study of nosocomial cross-transmission [25]. Thus, it is recommended to identify Candida parapsilosis complex at species level.

Thanks to the development of matrix-assisted laser desorption ionization time-of-flight mass spectrometry (MALDI-TOF MS), it becomes easy, fast and convenient to identify Candida parapsilosis at the species level. Most of previous reports (Table 2) did not give out definite method to identify the Candida parapsilosis and they also did not identify it at the species level. Usually, conventional phenotypic identification techniques and gene sequencing are the main methods used to identify the microorganisms in clinical microbiology laboratories.

### Table 2 Cases and clinical management of Candida Parapsilosis complex prosthetic valve endocarditis

| Age/Sex | Interval | Diagnosis | Blood culture | Culture from focus | Antifungal drugs | Surgery | Maintenance therapy | Initial therapy | Survive | Author and references |
|---------|----------|-----------|---------------|-------------------|------------------|---------|---------------------|----------------|---------|----------------------|
| 55/F    | 22 days  | +         | /             | /                 | /                | /       | /                   | /              | No      | Otaki et al [14]     |
| 67/M    | /        | +         | /             | /                 | amphotericin B, flucytosine | Yes     | Oral fluconazole 400 mg daily | No             | Yes     | Darwazah et al [15]  |
| 59/M    | 11 months| +         | +             | /                 | amphotericin B, flucytosine | Yes     | Fluconazole, 200 mg daily, for six months | Yes             | Yes     | Jones et al [16]     |
| 82/M    | 5 months | /         | +             | 7.6 g AmBisome    | Yes              | /       | /                   | No             | No      | Jones et al [16]     |
| 54/M    | /        | /         | +             | amphotericin B fluconazole | Yes     | Amphotericin B and flucytosine | Yes             | No      | Kumar et al [17]     |
| 44/F    | 6 weeks  | +         | /             | /                 | caspofungin, amphotericin B | Yes     | Oral antifungal suppressive therapy | /              | Mvondo, et al [18]  |
| 36/M    | 10 months| /         | +             | /                 | caspofungin, amphotericin B | Yes     | Oral antifungal suppressive therapy | Yes            | Yes     | Pepe et al [19]      |
| 35/F    | 3 years  | /         | +             | /                 | Amphotericin B, | Yes     | /                   | No             | No      | Shokohi et al [20]   |
| 47/M    | 2 years  | +         | /             | /                 | Amphotericin B, 5-flucytosine, micafungin | Yes     | Suppressive therapy with fluconazole | Yes             | Yes     | Silva-Pinto et al [21] |
| 31/F    | /        | +         | +             | Amphotericin B    | Yes              | /       | Chronic suppression with fluconazole | Yes             | No      | Kabach et al [22]    |
| 69/M    | /        | +         | amphotericin B, micafungin, fluconazole | No     | Chronic suppression with fluconazole | Yes     | /                   | No             | No      | Ahuja et al [23]     |
| 45/M    | > 10 years| +         | /             | amphotericin B, micafungin, fluconazole | No     | Long-term prescription of fluconazole and fluconazole | Yes            | Yes     | Ahuja et al [23]     |
| 24/F    | 5 years  | +         | /             | /                 | /                | Yes     | Oral caspofungin and daily aspirin | Yes             | Yes     | Tan et al [24]       |
| 55/M    | 5 years  | +         | /             | /                 | Voriconazole, caspofungin | No      | /                   | Yes             | Yes     | Our report           |
| 71/M    | 6 months | +         | /             | /                 | Voriconazole, caspofungin, amphotericin B | No     | Caspofungin 50 mg once a week and amphotericin B 30 mg once a week | Yes             | Yes     | Our report           |
| 70/M    | 4 years  | +         | /             | /                 | Voriconazole, fluconazole | No     | /                   | No             | No      | Our report           |
| 64/M    | 3 years  | +         | /             | /                 | Fluconazole, caspofungin | No     | /                   | No             | No      | Our report           |
Table 3 Combination antifungal therapy during period of hospitalization

| Case 1 | 2017/12/24 | 12 days | Voriconazole | 12–25 to 12–28 | 200 mg IV Q12H | Caspofungin | 12–28 to 1–8(2018) | 50 mg Q12H iv | / | / | / |
| Case 2 | 2019/11/4 | 31 days | Voriconazole + | 11–4 to 11–21 | 200 mg IV Q12H | Caspofungin | 11–21 to 12–4 | 50 mg Q12H iv | Amphotericin B | 11–26 to 12–4 | 1 mg IV QD |
| Case 3 | 2015/11/22 | 14 days | Fluconazole | 11–23 to 11–27 | 100 ml IV QD | Voriconazole | 11–27 to 12–4 | 200 mg IV Q12H | / | / | / |
| Case 4 | 2019/11/7 | 4 days | Fluconazole | 11–7 to 11–9 | 100 ml IV QD | Caspofungin | 11–9 to 11–10 | 50 mg QD iv | / | / | / |
With the development of MALDI-TOF MS, this technology has been adopted in clinical microbiology and it tends to be a gold standard for microbial identification [26]. On the one hand, MALDI-TOF MS can give accurate identification of most Gram-positive, Gram-negative bacterial strains and yeast isolates at the species level [27]. On the other hand, it is easy, fast, cheap, and efficient. This technology identifies each microorganism according to the analysis of mass spectra of the microorganism’s protein. By comparing the mass spectrum of the identifying microorganism with that in database of reference spectra, the microorganism could be identified at the family, genus, or species level [28]. Moreover, we usually just need pick a colony from a culture plate to spot on the target plate and add the matrix to the spot. After drying, the target plate should be taken to the mass spectrometer’s ionization chamber and the analysis can be finished within a few minutes. MALDI-TOF MS as an easy, fast and efficient identification method has advantages over conventional methods and owns the potential to influence clinical diagnostics and microbial research in the future, making it worth promoting.

No definitive treatment is recommended for Candida parapsilosis complex PVE and consensus on the best medical treatment and its duration is limited. In recent years, the therapy tends to become combination antifungal therapy and the use of echinocandin is increasing [29, 30]. The echinocandins are newly developed class of synthetic antifungals which could inhibit the synthesis of 1,3-β-D-glucan synthase noncompetitively. Moreover, echinocandins can be used against the fluconazole-resistant Candida parapsilosis complex. Although the Candida parapsilosis complex may have echinocandin resistance but it is uncommon. In our case series, the combination antifungal therapy for them were mainly the combination of azoles and echinocandins and the combination antifungal therapies for them during period of hospitalization were shown in Table 3. Moreover, the therapy obtained good outcomes in the patients who came to the hospital earlier, indicating early diagnosis and prompt antibiotic therapy were essential during the treatment of Candida parapsilosis complex PVE. Usually, the clinical features of Candida parapsilosis complex PVE are non-specific. In our case series, the patients only presented fever or shortness of breath. Case 1 and case 2 came to see a doctor within one month when the symptoms appeared while case 3 and case 4 saw the doctor 2 months later. The outcomes of case 1 and case 2 were successful medical therapy while the conditions of case 3 and case 4 deteriorated, making it important to diagnose Candida parapsilosis complex PVE as early as possible. Besides, in the previous reports, the case in Tan’s report was admitted one month after initial symptoms and the case in Silva-Pinto’s report was admitted ten days after initial symptoms [21, 24]. These cases all had a successful medical therapy. However, the case of Shokohi who was admitted 35 days after initial symptoms died after a series of emergency measures [20]. The other cases didn’t give out definite time point. In fact, the cases concerning the Candida parapsilosis complex prosthetic valve endocarditis are relatively few and some cases didn’t present them in detail. Although the reasons for the outcomes of the patients varied, it is undeniable that early diagnosis influences the outcomes of the patients from the limited cases. Fungus is opportunistic pathogen and fungal infections are an important cause of morbidity and mortality in the immunocompromised population. On the one hand, the therapy that could reduce immunity such as the use of glucocorticoid may increase the risk of Candida parapsilosis complex PVE in patients who underwent valve replacement. On the other hand, the physical conditions of the patients could influence the risk of Candida parapsilosis complex PVE. When treating immunocompromised patients who had valve replacement, we should watch out for Candida parapsilosis complex PVE.

Through up-to-date review of all previous cases, 12 cases of Candida parapsilosis complex prosthetic valve endocarditis had been reported (Table 2). Besides, two articles described outbreaks of Candida parapsilosis prosthetic valve endocarditis following cardiac surgery, including 8 dead cases and one alive case without detailed information [31, 32]. Among the listed cases including our cases, 9 cases both chose antifungal drugs and valve replacement to treat Candida parapsilosis complex prosthetic valve endocarditis while the treatment for it tended to combination antifungal therapy rather than surgery in the Ahuja’s cases. The literature about Candida parapsilosis complex PVE is limited. Moreover, most of previous reports did not give out detail description of their cases. Thus, more literature with detailed description about Candida parapsilosis complex PVE and the management of it is needed, providing reference to clinicians when treating Candida parapsilosis complex PVE.

In summary, our study raises significant learning points about the medical management and combination antifungal therapy for Candida parapsilosis complex PVE, providing reference for the treatment of Candida parapsilosis complex PVE to other clinicians. These cases also emphasize the challenges when treating Candida parapsilosis complex PVE. Besides, it is recommended to identify Candida parapsilosis complex at species level. MALDI-TOF MS as an easy, fast and efficient identification method is worth promoting in clinical microbiology diagnostics and microbial research in the future. Early diagnosis and prompt antibiotic therapy may play a role in the treatment for Candida parapsilosis complex PVE
and more attention should be paid to the immunocompromised patients who underwent valve replacement.

Supplementary Information
The online version contains supplementary material available at https://doi.org/10.1186/s12941-020-00409-4.

Additional file 1: Table S1. Routine analysis of blood, infectious and cardiac function indexes, and indicators of coagulation function on the day of admission.

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Authors’ contributions
Penghao Guo designed the work; Kang Liao have drafted the work and Peiwen Wu was responsible for the acquisition of the data and Yuli Huang was responsible for the imaging processing. All authors read and approved the final manuscript.

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Ethics approval and consent to participate
The approval for our study was obtained from the institutional review board of the First Affiliated Hospital, Sun Yat-sen University. All patients and their next to kins received detailed counseling and informed written consent to publish for this study was obtained from each participant or their next to kins.

Consent for publication
Not applicable.

Competing interests
The authors declare that they have no competing interests.

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