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Preoperative Oral Health Screening Prior to Cardiovascular Intervention: A Case Report

Skrining Kesehatan Mulut Pra Operasi sebelum Intervensi Kardiovaskular: Laporan Kasus

Stephani Dwiyanti[1*], Benyamin Benyamin[2], Maria Zita[2], Maria RM Ole[2], Jennifer Wiranatha[2]

[1] Department of Dental Medicine, School of Medicine and Health Sciences, Atma Jaya Catholic University of Indonesia, Jakarta, Indonesia

[2] School of Medicine and Health Sciences, Atma Jaya Catholic University of Indonesia, Jakarta, Indonesia

[*]Corresponding author

Email: stephani.dwiyanti@atmajaya.ac.id

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Abstract

Valvular heart disease causes impaired function and decreases the quality of life. This condition could be managed surgically, but preoperative oral health screening is needed to eliminate oral infection. This paper aims to review common clinical findings in oral examination procedures, give an overview of the relationship between oral health and cardiovascular disease, and differentiate between pathological and typical findings in the oral cavity. A 34-year-old woman with valvular heart disease was referred for oral health evaluation and treatment before elective heart valve surgery. She was routinely medicated with Warfarin. She needed extraction of a fractured tooth, restoration of carious teeth, and scaling. Less urgent findings such as abfractions, gingival recession, malposed, and missing teeth could be treated after heart surgery. It was suggested that she not stop Warfarin and take Amoxicillin before dental procedures. In conclusion, general practitioners (GPs) play a significant role in the early detection of commonly found dental problems, especially in patients with cardiovascular disease who are about to undergo surgical intervention. GPs should be able to perform basic oral examinations, provide basic oral health education, know when to use antibiotic prophylaxis or discontinue anticoagulants wisely, and make timely referrals for patients requiring further dental management.

Keywords: *antibiotic prophylaxis; anticoagulant; heart valve surgery; infective endocarditis; oral health screening*

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Abstrak

Penyakit katup jantung menyebabkan gangguan fungsi dan menurunkan kualitas hidup. Kondisi ini dapat ditatalaksana dengan pembedahan, tetapi diperlukan skrining kesehatan mulut preoperatif untuk menghilangkan sumber infeksi oral. Laporan kasus ini bertujuan untuk meninjau temuan klinis yang umum ditemukan pada pemeriksaan oral, memberikan gambaran hubungan antara kesehatan oral dan penyakit kardiovaskular, serta membedakan antara temuan patologis dan temuan tipikal di rongga mulut. Wanita berusia 34 tahun dengan penyakit katup jantung dirujuk untuk mendapatkan evaluasi dan tatalaksana masalah kesehatan mulut sebelum operasi katup jantung. Pasien rutin mengonsumsi Warfarin. Pada pemeriksaan, pasien memerlukan ekstraksi gigi yang fraktur, restorasi gigi yang karies, dan *scaling*. Masalah yang kurang mendesak seperti abfraksi, resesi gingiva, malposisi gigi, serta gigi yang hilang dapat diterapi setelah operasi katup jantung. Pasien disarankan untuk tidak menghentikan konsumsi warfarin, tetapi mengkonsumsi amoxicillin sebelum prosedur gigi. Sebagai kesimpulan, dokter umum berperan signifikan dalam deteksi dini masalah rongga mulut, terutama pada pasien dengan penyakit kardiovaskular yng akan menjalani intervensi bedah. Dokter umum harus dapat melakukan pemeriksaan gigi dan edukasi kesehatan gigi dasar, serta mengetahui kapan perlu memberikan profilaksis antibiotik atau menghentikan antikoagulan dengan bijak, serta merujuk pasien yang memerlukan perawatan gigi lebih lanjut.

Kata kunci: antibiotik profilaksis; antikoagulan; endokarditis infektif; operasi katup jantung; skrining kesehatan mulut

Introduction

Cardiovascular disease is the leading cause of death in the world.[1] According to the World Health Organization (WHO), more than four out of five deaths in cardiovascular disease are caused by heart attack and stroke.[1,2] A report from the Global Burden of Cardiovascular Diseases (CVD) 1990–2019 stated that the prevalence of cardiovascular disease in 1990 was 271 million cases, and in 2019, it was 523 million.[2] The number of CVD deaths had also steadily increased from 12.1 million cases in 1990 to 18.6 million in 2019.[2] In Indonesia, the 2018 National Basic Health Research Report (*Riset Kesehatan Dasar/Riskesdas*) mentioned that 1.5% of the Indonesian population suffers from cardiovascular disease.[3] A type of cardiovascular disease that causes impaired function and decreases the quality of life is valvular heart disease, defined as a structural or functional abnormality of the cardiac valves, including aortic and pulmonary valves.[4]

Management of cardiovascular disease includes non-pharmacological, pharmacological, surgical treatment, and other invasive procedures, such as cardiac pacemaker implantation, cardiac stent placement, and heart valve surgery.[5] As with surgery in general, preoperative health screening is needed to prevent complications. Oral health is one of the many conditions that must be assessed before heart surgery, particularly heart valve surgery.[5–7] Infective endocarditis (IE) is inflammation of the endocardium, heart valves, atria, and ventricles walls.[8] This condition could be caused by bacteria, viruses, and fungi that spread in a hematogenous

way from another part of the body that had prior infection.[8] This disease caused 20% mortality in 30 days.[9] As a result, there is increased attention to oral health. Currently, guidelines from the European Society of Cardiology (ESC) and the American Heart Association (AHA) support performing dental examinations and procedures before elective cardiac surgery to eliminate sources of infection in the oral cavity.[6,10]

In Indonesia, oral diseases are among the most common health problems encountered, with caries prevalence reaching 88.8%, root caries at 56.6%, and periodontitis at 74.1%.[3] There is a high possibility that patients with cardiovascular disease also suffer from oral diseases. Unfortunately, many healthcare professionals do not understand basic oral healthcare advice, screening, and managing dental infections.[11] In fact, medical and dental education has remained separated for decades.[12] Also, few studies cover practical topics for general practitioners (GP) regarding oral health and cardiovascular disease. Therefore, basic oral health-related training is necessary for healthcare workers to provide comprehensive care and proper counseling regarding oral problems and their causes, prevention, treatment, and oral health issues in general.[13]

This paper aims to review some common clinical findings in oral examination procedures, overview the relationship between oral health and cardiovascular disease, and differentiate between pathological and typical findings in the oral cavity. It also aims to encourage collaborative management between dentists and general health practitioners. As such, medical practitioners can provide good clinical recommendations regarding oral health problems and reduce the risk of IE in cardiovascular patients.

Case Description

A 34-year-old woman with valvular heart disease was referred by her cardiologist to the dental clinic of Atma Jaya Teaching and Research Hospital and was screened by co-assistant doctors. She was scheduled for heart valve surgery and was suggested to undergo oral health evaluation and treatment before the operation. Her chief complaint was a broken upper left tooth, which happened six months before her visit. She had no pain in any part of her oral cavity. Some of her teeth had already been extracted, but she wore no dentures. For her heart condition, she was routinely medicated with warfarin, digoxin, ramipril, and bisoprolol since 2015.

For dental history, she did not visit her dentist for routine dental examinations. The latest dental procedure she underwent was the extraction of her upper right tooth in December 2021. She brushes her teeth twice daily, once in the morning and once in the afternoon, for two to

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three minutes. She brushes up and down, left to right, and circularly. There are times when she gargles using mouthwash after toothbrushing. She also has a habit of eating sweet and sour food and food with a hard consistency. She had never used dental floss to clean her oral cavity.

No abnormalities were found upon extraoral examination. Intraoral examination revealed a white horizontal line on both sides of the buccal mucosa (figure 1A). Her tongue showed some fissures and was lightly coated with plaque (figure 1B). Hyperpigmentation was found on the labial gingiva of the upper and lower jaw. Almost all posterior teeth showed gingival recession without any sign of inflammation. Meanwhile, dental calculus and gingivitis were found on the lingual part of the lower anterior teeth.

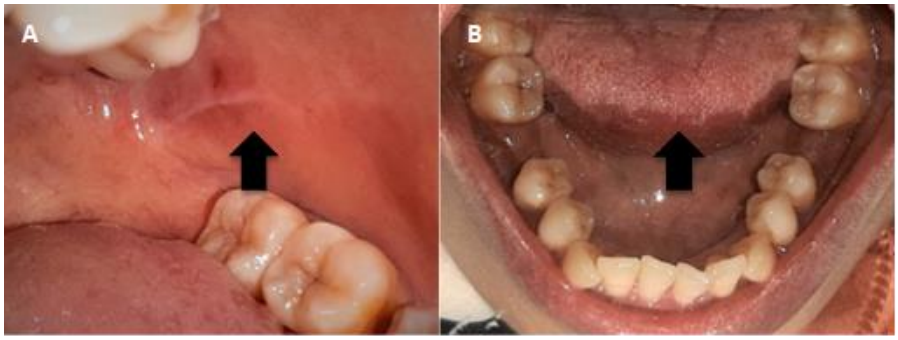

Figure 1. Normal Variation of the Oral Cavity
A. Linea Alba is shown as a white line that streaked across the occlusal plane
B. The dorsal surface of the tongue showed some fissures and was coated with white

A dental examination was performed using the *Federation Dentaire Internationale* (FDI) notation. The patient had a tooth with a fracture reaching the pulp (tooth 26), her chief complaint. There were five carious teeth: teeth 16,15,24 with caries on the proximal part and teeth 37 and 47 with caries on the occlusal part (figure 2A, 2B, 3A). There were four missing teeth (teeth 14, 25, 36, 46) as shown in figure 2. She also had six teeth with abstraction (16, 24, 37, 35, 45, 47), as shown in figure 3. Malposition can be found in some anterior teeth, exhibiting staining on the palatal side.

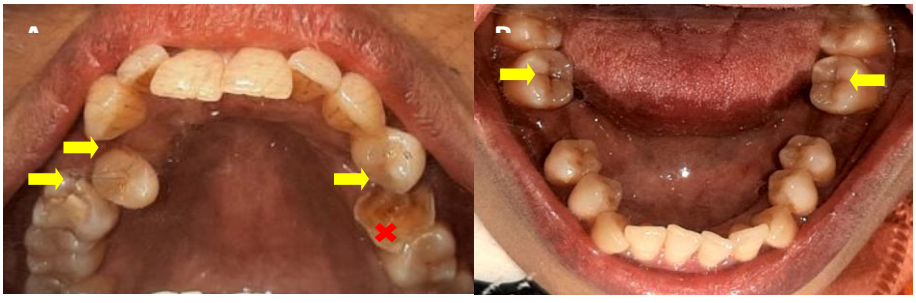

Figure 2. Occlusal View of Patient's Upper and Lower Jaw
A. Upper jaw showed three carious teeth marked in yellow (teeth 16,15, 24) and one fractured tooth marked in red (tooth 26)
B. Lower jaw showed two carious teeth marked in yellow (teeth 37 and 47)

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Additional examination in the form of a panoramic radiograph was performed to support clinical findings (figure 4). The panoramic x-ray confirmed that both lower first molars were missing, and no root remnants were found in the bone. The upper first left molar showed a fracture already reaching the pulp. All other teeth did not exhibit radiographic signs of caries or abfraction, although they were clinically visible. The alveolar bone level was average, and the jaw had no abnormality.

Figure 3. Frontal View of Patient's Upper and Lower Jaw.
A. Left View. Teeth 16 and 15 showed caries on the proximal part (shown in yellow arrow). Abfraction was also found on teeth 16, 45, and 47 (shown in the black arrow).
B. Front View. Brownish hyperpigmentation was found on the labial gingiva of both jaws. Gingival recession (shown in red arrow) is found in almost all canines, premolars, and molars.
C. Right View. Abfraction on teeth 24, 35, and 37 (shown in black arrow).

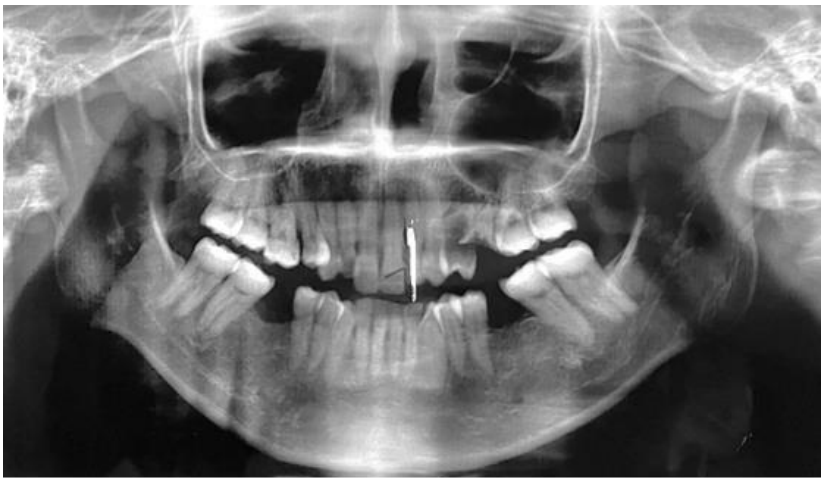

Figure 4. Panoramic Radiograph
A fractured tooth was found in tooth 26. Early carious lesions could not be detected radiographically.

Based on history taking, clinical, and radiographic examination, some oral problems needed to be prioritized before the patient's cardiac surgery, while others could be treated later. Fractured tooth 26 must be extracted first (figure 5), followed by the restoration of all carious teeth. Scaling was also performed to remove the stain and calculus and reduce gingival inflammation. Meanwhile, abfractions and gingival recession with no signs of inflammation could be treated after her surgery. Other clinical findings, such as linea alba and hyperpigmentation, did not require any treatment. The patient was also educated that her

malposed teeth could be managed with orthodontic treatment, and missing teeth should eventually be replaced with dentures.

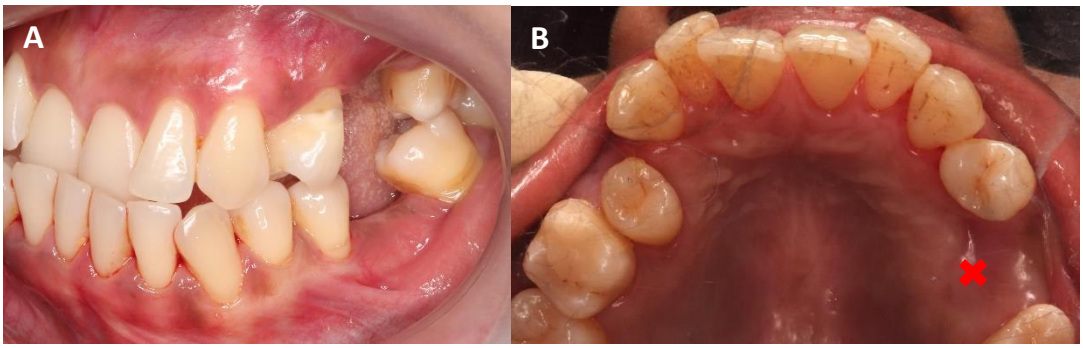

Figure 5. Intra Oral Condition after Extraction of Tooth 26
A. Right View. Tooth 26 was already extracted.
B. Upper jaw: Missing tooth 26 with a healed mucosa (shown in red cross). Caries on 16,15 and 24 were already restored.

Due to her risk of infective endocarditis, dental health education was highly emphasized to the patient. This covered basic toothbrushing techniques, flossing, and rinsing habits. The patient was reminded to brush her tongue to remove the white plaque and to come for routine recall every six months. The patient was instructed to brush her teeth once after breakfast and once before sleeping and not to consume anything other than plain water after brushing her teeth at night. She was informed not to have too much sweet, sour, or hard-consistency food. She was encouraged to use Casein Phosphopeptide-Amorphous Calcium Phosphate (CPP-ACP) to prevent caries formation. Regarding her dental treatment, the patient was suggested not to stop her anticoagulant (Warfarin) before any dental procedures. However, she was reminded to take 2 grams of Amoxicillin before dental extraction and scaling.

Discussion

According to the Indonesian National Standard of Doctor's Profession Education/*Standar Nasional Pendidikan Profesi Dokter Indonesia* (SNPPDI) 2019, GP should be able to treat thoroughly several oral conditions, namely oral candidiasis, oral ulcers (aphthous or herpetic), and parotitis.[14] General practitioners should be able to diagnose, provide initial treatment, and refer cases of glossitis, Ludwig's angina, caries, and gingival infection.[14] Therefore, integrating dental education into the medical curriculum is essential for students to increase their awareness and understanding of oral health.[15]

There are a few essential preoperative health assessments someone needs to undergo before surgery, especially cardiac surgery. This includes a comprehensive extraoral and intraoral examination of the complex and soft tissues for any lesions or infection, oral hygiene

assessment, vitality test of the dental pulp, exploration of dental decay/caries, restorations and prosthetics, evaluation of periodontium, and radiographic examination for evidence of caries, infection of the surrounding structures, and moderate to severe periodontal diseases.[5]

Several oral health problems could be found in this patient, with multiple caries as one of the prominent problems. Demineralization occurs due to the interaction of several variables: bacteria, diet, tooth morphology (pit fissure and proximal area), time, saliva, and systemic condition (poorly controlled diabetes mellitus, Sjogren Syndrome).[16] Acidogenic bacteria such as *Streptococcus mutans* metabolize sucrose found in a high-sugar diet through fermentation, resulting in acid as the by-product.[16] Acid decreases the pH level of plaque, and when it drops below 5.0 to 5.5, demineralization occurs. The next phase is the enamel breakdown, marked by a visible white spot on the tooth surface and followed by cavity formation.[16] This clarifies some misconceptions that assume caries are always in cavities with irregular shapes and soft structures. To identify caries, healthcare professionals should screen for white spots and cavities.

At the very least, healthcare professionals should have basic knowledge regarding caries management to provide basic patient recommendations. First, good oral hygiene habits should be reinforced. One mistake in the patient's oral hygiene is that she does not brush her teeth before bed and does not floss. Teeth are more vulnerable to demineralization at night because of decreased salivary production and its protection against cavities.[16,17] Flossing helps clean the interproximal area of teeth, an area prone to caries formation.[16]

Caries is a diet-related disease. A sugary diet should be avoided.[16] Vegetables are more favorable due to their low sugar content.[16] Chewing fibrous food stimulates jaw movement and increases salivary production.[16] Patients should also be advised to avoid snacking between meals. Frequent ingestion of sugar during the day will cause an imbalance in the rate of demineralization and remineralization, that when persists for an extended period, will cause a gradual loss of minerals from the enamel and its subsequent breakdown.[16]

The carious lesion is managed according to its stage. Recent studies have shown that the application of CPP-ACP-containing paste effectively promotes the remineralization of early carious lesions and prevents demineralization.[18] CPP-ACP provides a pool of calcium and phosphate ions and maintains the supersaturation of saliva.[18] It also keeps high levels of calcium and phosphate in plaque.[18] When demineralization occurs, CPP-ACP will release calcium and phosphate levels, leading back to remineralization.[18]

Dental caries are strongly linked to cardiovascular disease.[7] Untreated caries can progressively reach the pulp, lead to root canal infection, and spread to the supporting structures

of the teeth, which could be an entry point for the systemic spread of infection.[7,19] When bacteria enter the blood vessels, an intravascular inflammatory response will damage blood vessels and impair vascularization.7,19 Infection from caries can also reach the heart and cause IE.[7,19] In this patient, tooth 26 has decay and fracture that has already reached the pulp, making it the possible cause for the systemic spread of the infection. Therefore, this tooth is highly prioritized and needs to be extracted immediately.

Gingivitis could also be observed in this patient. Diagnostic features of gingival inflammation are not challenging to detect, and health professionals can be trained to spot them. Inflamed gingiva is red, depicts some swelling and bleeding, and has shiny surfaces.[20] There are several possible etiologic agents of gingivitis which are usually found in periodontal pockets, such as *Streptococcus sp*., *Fusobacterium sp*., *Actinomyces sp*., *Veillonella sp*., and *Treponema sp*.[20] Intraoral infections, such as gingivitis and periodontal diseases, are often associated with cardiovascular disease. Two proposed mechanisms link the two: direct action of oral bacteria on the vasculature and indirect bacterial actions through systemic inflammation. In the direct mechanism, bacteria access the ulcerated epithelium lining of periodontal pockets and enter the systemic circulation. Bacteria then invade the endothelial layer with the production of proinflammatory cytokines.[7] Transmigrating phagocytes also carry oral bacteria from the periodontal pockets through the bloodstream and deposit them in vascular sites.[7] In the indirect mode, the local inflammatory point created by periodontal inflammation can increase vascular inflammation systemically.[7] The gingival condition of this patient is not severe. However, it is still a potential source of systemic inflammation and needs to be treated immediately – in this case, through scaling and root planning.

Bacteremia usually happens following invasive procedures, but it was stated that toothbrushing is a new potential risk for IE.[8] When bacteremia occurs, the microbial Surface Component Reacting with Adhesive Matrix Molecules (MSCRAMMs) found on the surface of pathogens mediate the attachment and adhesion process to the 'non-bacterial thrombotic endocarditis' (NBTE) or the endocardium.[8] The endocardial bacterial invasion promotes inflammatory response and coagulation cascade, subsequently forming the infective vegetation (figure 6).[8]

People with coexisting heart diseases, such as congenital heart defects, prosthetic heart valves, previous IE, cardiac transplants with successive valvulopathies, intravenous drug users, and a history of IE have a greater risk for developing IE.[8,9] High-risk patients, just like our patient, may be prescribed prophylaxis antibiotics before specific dental procedures involving gingival manipulation, periapical manipulation, or oral mucosa perforation[8,21]

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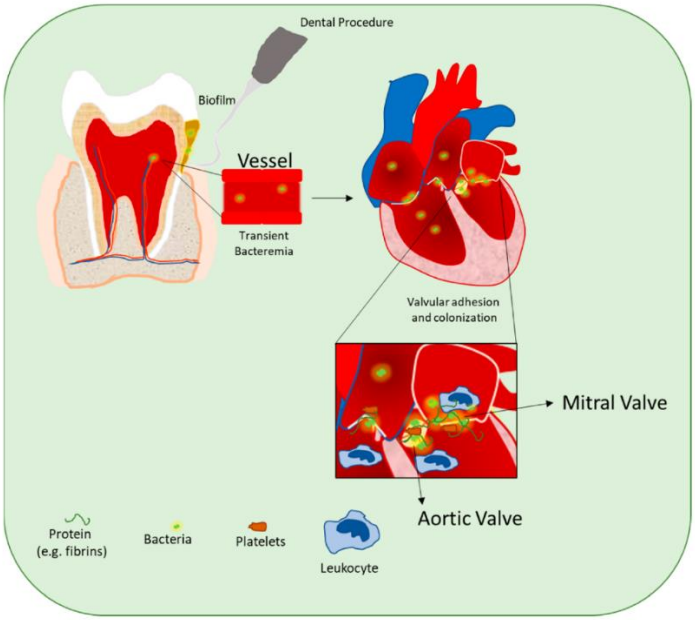

Figure 6. Schematic Representation of Endocarditis Development after Dental Procedures[8]

The 2021 AHA Scientific Statement on preventing infective endocarditis recommends a single dose of prophylactic antibiotic to be given 30 to 60 minutes before the procedure (table 1).[21] If it has not been given before the procedure, a single dose of prophylactic antibiotic from a different group may be given 2 hours after the procedure.[21] In our case, the patient has preexisting heart valve disease and thus is at higher risk of developing IE, so she was given 2 grams of amoxicillin orally as a prophylactic antibiotic for some treatments such as extraction and scaling.[21] Knowledge regarding antibiotic prophylaxis is essential for medical practitioners, especially in referral cases from dental practitioners who sometimes ask for recommendations on whether it is okay to proceed with specific dental treatments, given the patient's heart condition.

Table 1 Antibiotic Regimens for a Dental Procedure Regimen: Single Dose 30 to 60 Minutes Before Procedure[21]

Situation	Agent	Adults	Children
Oral	Amoxicillin	2 g	50 mg/kg
Unable to take oral medication	Ampicillin OR	2 g IM atau IV	50 mg/kg IM or IV
	Cefazoline or ceftriaxone	1 g IM atau IV	50 mg/kg IM or IV
Allergic to penicillin or ampicillin - oral	Cephalexin OR	2 g	50 mg/kg
	Azithromycin or clarithromycin OR	500 mg	15 mg/kg
	Doxycycline	100 mg	<45 kg, 2.2 mg/kg >45 kg, 100 mg
Allergic to penicillin or ampicillin and unable to take oral medication	Cefazoline atau ceftriaxone	1 g IM atau IV	50 mg/kg IM or IV

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The clinician decided that the patient should not stop her anticoagulant before oral surgery. There have been misconceptions regarding the discontinuation of anticoagulants before oral surgery, in which many practitioners advise patients to stop antiplatelet/anticoagulant for 3-5 days before surgery. Now, there is a universal consensus stating that anticoagulation therapy (warfarin or direct oral anticoagulant therapy) should not be suspended for most oral surgeries because the risk of developing emboly, which is often fatal, is greater than the risk of bleeding complication.[22]

During intraoral examination, normal oral variations such as linea alba and gingival hyperpigmentation were observed. Linea alba presents an asymptomatic, whitish, linear, filament-like formation and is often found bilaterally along the occlusal level.[23] As for hyperpigmentation, she did not smoke nor consume any medication, and according to the patient, the pigmentation did not seem to spread. As a result, the clinician considers this as physiologic hyperpigmentation. Normal variations in this patient do not need any treatment. According to a study on the prevalence of oral mucosal normal variations and lesions by Oivio et al., the five most common oral variations found are Fordyce granules, fissured tongue, geographic tongue, hairy tongue, and linea alba.[24] General practitioners should at least know common normal oral variations and be able to discriminate between normal versus abnormal oral findings through a simple examination and make appropriate dental referrals, if necessary.

There were multiple abfractions found in this patient. Abfraction, typically caused by the concentration of occlusal stress around the cervical area, is commonly found on the buccal surfaces and generally is wedge- or V-shaped lesions with well-defined internal and external angles.[25] Although abstraction and caries are hard-tissue lesions, they are easily differentiated. While abfraction has V-shaped lesion and hard surface, caries is irregularly shaped and has soft surfaces with plenty of plaque. In this patient, the teeth with abfraction do not seem to cause plaque accumulation that can lead to infection; therefore, restorations are not a priority and could be scheduled after the patient's heart surgery.

Conclusion

Oral health is strongly linked to cardiovascular disease. Knowledge and skill in basic oral health are essential for medical practitioners. In this case, general practitioners and other primary health workers play a significant role in the early detection of common dental problems (normal oral variation, caries, and periodontal diseases), especially if the patients have underlying medical conditions like cardiovascular disease and are about to undergo cardiovascular intervention. GPs should be able to perform basic oral examinations, provide

basic oral health education, know when to use antibiotic prophylaxis or discontinue anticoagulants wisely, and make timely referrals for patients requiring further dental management.

Acknowledgment

Written informed consent was obtained from the patient before the commencement of the study. The authors declare that they have no conflict of interest. All authors took part in the design and writing of the manuscript. Ethical clearance for this research was granted before the commencement of the study by the Research Ethics Committee of the School of Medicine and Health Sciences at the Atma Jaya Catholic University of Indonesia.

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