Int. J. Odontostomat.,
17(4):498-504, 2023.

Endodontic treatment as a Reduction in the Risk of infective Endocarditis in a Male Patient with Eisenmenger Syndrome

Tratamiento Endodóntico como Reducción del Riesgo de Endocarditis Infecciosa en un Paciente Masculino con Síndrome de Eisenmenger

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PIAI, G. G.; QUISPE, R. A.; COELHO, L. A. S.; DUARTE, M. A. H.; DA SILVA SANTOS, P. S. & VIVAN, R. R. Endodontic treatment as a reduction in the risk of infective endocarditis in a patient with Eisenmenger syndrome. *Int. J. Odontostomat., 17(4)*:498-504, 2023.

ABSTRACT: This case report aimed to describe the importance of endodontic treatment in reducing infectious foci in patients with Eisenmenger syndrome (ES) and describe the characteristics of ES, so that the endodontist can safely treat these patients. A 57-year-old male with ES sought dental care complaining of dental pain. Irreversible pulpitis was diagnosed in tooth 37 and pulp necrosis in teeth 36, 34 and 31. Tests of prothrombin time (PT), activated partial thromboblastin time (APTT) and international normalized ratio (INR) were prescribed to evaluate the profile of coagulation using Marevan and antibiotic prophylaxis with amoxicillin. The endodontic treatments were performed. At the end, the patient reported no pain or discomfort in the teeth and improved masticatory function. The removal of oral infectious foci in patients with ES is important to reduce the risk of IE, which could seriously compromise the health and overall prognosis of the patient.

KEY WORDS: Eisenmenger complex, endocarditis, endodontics, infections, quality of life.

INTRODUCTION

Eiseimenger syndrome (ES) is a severe form of pulmonary arterial hypertension caused by a bidirectional intracardiac shunt through a large ventricular septal defect, caused by increased pulmonary resistance (Das, 2015). This septal defect involves communication between the right and left ventricles, allowing blood to flow freely from one side to the other and mixing oxygenated blood with non-oxygenated blood (Calderón-Ávila *et al*., 2018).

Deoxygenated blood enters into general circulation and the patient presents with symptoms of hypoxia which is manifested mainly by digital clubbing of the hand and foot fingers, hemoptysis, iron deficiency with or without anemia, and organ damage (Bennett *et al*., 2014; Quispe *et al*., 2021).

Over time, the body compensates for the low oxygen content of the circulating blood by increasing the red blood cell count and, consequently, the blood viscosity that can lead to an increased risk of thromboembolic complications. Once ES is established, progressive fatigue, dyspnea, cyanosis, and reduced peripheral perfusion occur (Arvanitaki *et al*., 2020). Overall, life expectancy is reduced and the main causes of death include ventricular arrhythmia, thromboembolism, or complications of non-cardiac surgery, including dental surgery (Butler *et al*., 2007).

Individuals with ES exhibit a greater susceptibility to developing serious oral infectious processes, including a high prevalence of periodontal and endodontic diseases (Chung *et al*., 2004; Kunimatsu

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Received: 2023-04-11 Accepted: 2023-09-29

et al., 2011; Quispe *et al*., 2021). The relationship between endodontic infections and systemic diseases is already known (Aminoshariae *et al*., 2017). Therefore, it is necessary that the endodontic specialist has knowledge of ES to manage the cases correctly.

As individuals with ES have a greater risk of infective endocarditis, infectious foci in the mouth can complicate the patient's general health status and even increase the risk of death. Therefore, the aims of this study are: a) to report a clinical case describing the importance of endodontic treatment in reducing infectious foci in patients with ES; and b) to describe the characteristics of ES, so that endodontists can safely treat patients with ES.

CASE REPORT

This case report was approved by the Human Research Ethics Committee (Process Number: 58819222.5.0000.5417).

A 57-year-old white male was diagnosed with Eisenmenger syndrome. As a consequence of the underlying disease, the patient also had pulmonary arterial hypertension, systemic arterial hypertension and a patent foramen ovale. He also had slow gait, agitation, and dyspnea.

The patient presented to the clinic with severe toothache. His pain evolved over 4 days, with nocturnal exacerbation, radiation to the left side of the mandible, and partially ceasing after particular emergency dental treatment without anesthesia. The patient reported that for several months he sought dental care, but without success because of his underlying disease. In his own words, he reported, “I have unbearable pain in my tooth and nobody wants to treat me”.

The patient recieved sildenafil 20 mg 3/d, anlodipino 10 mg 1/d, hidrocortiazida 25 mg 1/d and marevan 5 mg 1/d. On intraoral physical examination, tooth 37 presented with pain on apical palpation, and tooth 36 with asymptomatic caries. Radiographic examinations revealed radiolucent periapical areas consistent with infectious foci on teeth 34 and 31. Based on the clinical and radiographic findings, it was possible to diagnose and implement a dental treatment plan. After complete explanation of the treatment procedure, risks, and benefits, an informed consent was obtained from the patient.

Tooth 37 presented with irreversible pulpitis; teeth 36 and 34 with pulp necrosis; and tooth 31 with pulp necrosis along with apical resorption and grade I mobility. The need for endodontic treatment on all these teeth (37, 36, 34 and 31) was verified; tooth 37 showed painful symptoms and needed urgent treatment. Prothrombin time (PT), activated partial thromboblastin time (APTT) and international normalized ratio (INR) tests were also prescribed to assess the clotting profile, using Marevan. Antibiotic prophylaxis was performed with 2 g of amoxicilin, 1 h before outpatient dental care according to the American Heart Association protocol (Wilson *et al*., 2007).

A total of six dental care procedures were performed, two for each molar, one for the premolar and another one for the incisor. All teeth were biomechanically prepared with 2.5 % sodium hypochlorite (NaOCl) and instrumented with Reciproc system, considering the working length (WL) 1mm short of the apical foramen. At the end of the biomechanical preparation, the teeth were irrigated again with 2.5 % NaOCl followed by 17 % EDTA, both solutions were agitated three times for 30 seconds with an ultrasonic insert (Irrisonic, Helse). The canals were then washed with saline water and dried with absorbent paper. In those teeth which endodontic treatment was performed in two sessions, intracanal medication based on calcium hydroxide (Ultracal; Ultradent) was placed and remained for 7 days. For all teeth, obturation was performed using gutta-percha cone with the same diameter and taper as the last instrument used in the canal and AHPlus (Dentsply) endodontic cement. The technique adopted was vertical compression.

Table I. PT, APTT and INR variations in endodontic treatment sessions.

Exam	Session 1-2	Session 3-4	Session 5-6	Reference value
PT	26’	26’	28’	12-18’
APTT	42’	42’	44’	25-34’
INR	2,15	2,15	2,25	<1,2

PT= Prothrombin time; APTT= Activated Partial Thromboplastin Time; INR= International Normalized Ratio.

The values found in the coagulation tests varied among the dental care sections. The INR reference value is 1, and the higher the INR, the lower the blood clotting. When the expected

Table II. Monitoring vital signs before, during and after dental care

Session	Blood pressure (mmHg)			Heart rate			Oxygen saturation (%)		
	Before	During	After	Before	During	After	Before	During	After
1	140/90	150/90	130/90	88	92	77	87	95	92
2	130/90	140/90	130/90	75	80	78	84	97	90
3	140/90	130/90	130/90	77	75	75	85	95	92
4	140/90	140/90	130/90	75	80	80	85	95	90
5	130/90	140/90	130/90	70	85	78	86	95	90
6	140/90	130/90	140/90	75	85	80	88	95	90

bleeding is minimal, as in conventional endodontic treatments, the INR can be up to 4.0. However, the INR turn around 2 in all sections as we can see in Table I being the benefits of maintaining the anticoagulant greater than the risks (Jiménez *et al*., 2008). More than two tubes of mepivacaine with 3 % epinephrine were not used in any session.

Sessions lasting approximately 1 h 30 min were carried out, taking all the necessary care: patient always in the orthostatic position, blood pressure measurement before and after every consultation, monitoring of oxygen saturation by pulse oximetry and oxygen therapy ranging 3-5 l/min, adjusted according to O2 saturation. Variations in vital signs are described in Table II.

After completing the endodontic treatment of teeth 37, 36, 34 and 31, the patient was referred for restorative treatment to restore the anatomy and function of these teeth.

After the end of the endodontic treatment, the patient reported complete improvement of his main complaint, with no pain or dental discomfort; thus, improving his masticatory function and consequently, his quality of life. He also reported an improvement in general health (Fig. 1).

A 2-year clinical and imaging follow-up was performed. A regression of the periapical lesion of teeth 31 and 34 was observed on radiographic images acquired 2 years after the end of the treatment (Fig. 1). Teeth 36 and 37 had no apparent lesions on radiographic examination at the beginning of the treatment, therefore, the images obtained after 2 years remained similar (Fig. 1).

A cone beam computed tomography (CBCT) was also requested for follow-up (3D software Accuitomo 170 J. Morita, Kyoto, Japan). It is possible to observe a good condensation of the endodontic material in all the endodontic treatments, the obturation 1mm short of the working length as well as a repair of the periapical lesions (Fig. 2).

Fig. 1. Postoperative periapical radiographs of the tooth tooth 31 (A1) and teeth 34, 36, and 37 (B1). 2-year follow-up after endodontic treatment of the tooth 31 (A2) and teeth 34, 36, and 37 (B2).

On clinical examination after 2 years, the patient did not present with any signs or symptoms of inflammation and oral infection related to the endodontic treatments performed. Upon general physical examination, the patient was stable with no general complications, including a significant improvement in peripheral perfusion, and consequently, his general health status.

Due to the COVID pandemic, the patient has not yet been scheduled for definitive restorations, but all teeth remain sealed with glass ionomer cement. After evaluation, the patient has been referred for prosthesis on tooth 37 to complete his dental rehabilitation.

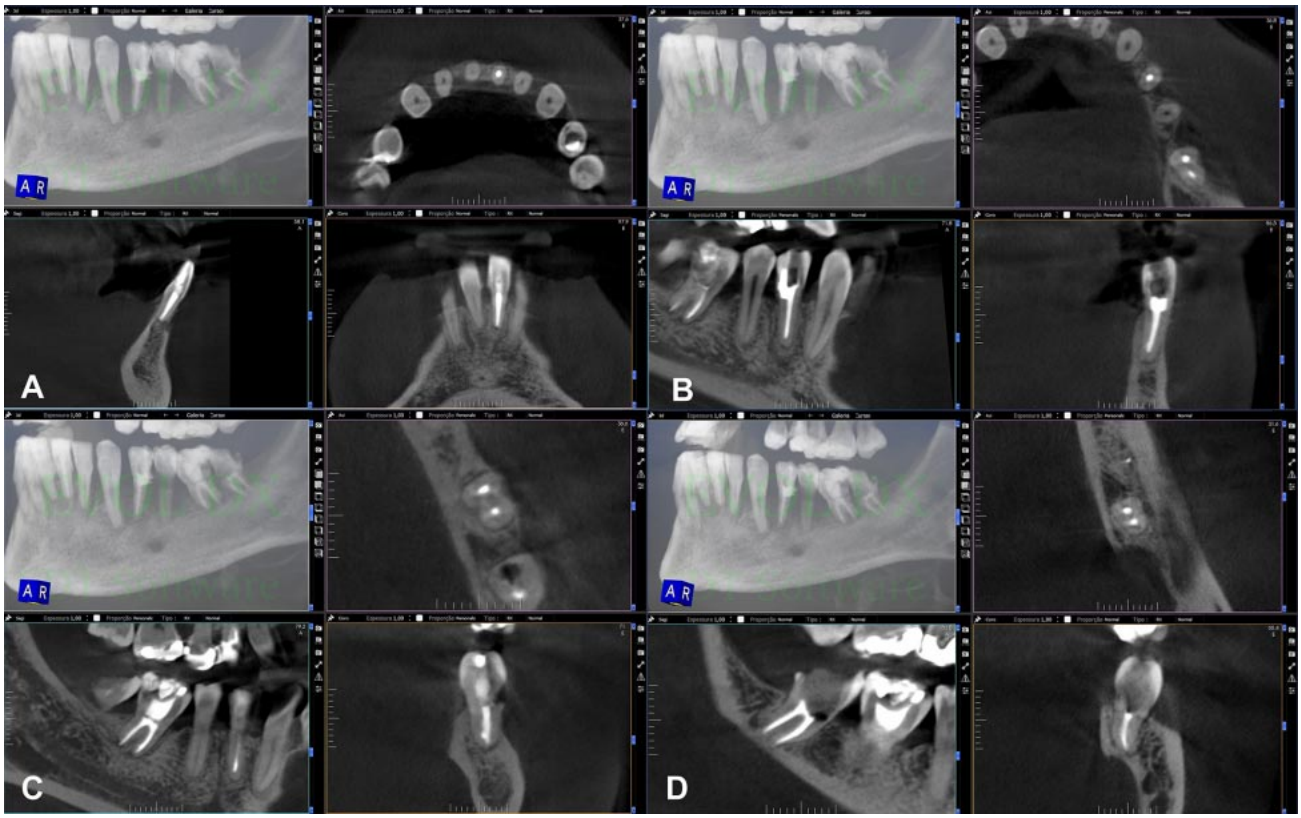

Fig. 2. Tomography of 2-year follow-up after endodontic treatment of the teeth 31 (A), 34 (B), 36 (C) and 37 (D).

DISCUSSION

ES is usually diagnosed in infants from 3 months of age or in children (Martin *et al*., 2002). The diagnosis of ES is established using clinical findings and confirmed by cardiac catheterization, doppler flow studies, and contrast echocardiography (Martin *et al*., 2002; Das, 2015; Calderón-Ávila *et al*., 2018). When diagnosed in late adulthood, cardiac surgical correction is rarely performed, and the patient has to live with the disease with a risk of mortality and reduced life expectancy (Oya *et al*., 2002).

The treatment of ES essentially consists of pharmacological therapy to reduce pulmonary pressure, supportive/palliative therapy, early corrective surgery of the septal defect, and heart and lung transplantation in severe cases (Arvanitaki *et al*., 2020). However, most patients with ES are considered as an inoperable subgroup of patients with an irreversible condition because of elevatedpulmonary vascular resistance that persists or worsens after surgical closure of the septal defect (Bennett *et al*., 2014).

To improve the quality of life and reduce the risk of infective endocarditis (IE) in patients with ES, dental treatment is essential so that these patients do not develop serious infections of oral origin (Butler *et al*., 2007; Calderón-Ávila *et al*., 2018). In addition, knowledge of the disease and its risks, medications in use, dental technical skills, and humanization of the dental surgeon in the clinical management of these patients are of extreme importance.

Patients with ES are at risk of developing IE. The second most frequent route for the entry of microorganisms of IE is the oral route (29 % of patients) (Duval *et al*., 2019). Transient infection occurs at all times, including at the time of tooth brushing; thus, it is important that the patient has good oral hygiene (Lockhart *et al*., 2008, 2009). Additionally, untreated dental infection imposes greater risk of IE than the dental treatment itself, which would cause hematogenous spread of microorganisms related to the dental focus, and a transient infection may also

occur (Calderón-Ávila *et al*., 2018). For this reason, the elimination of oral infectious foci by dentists for individuals with ES is very important. After dental treatment, the patient will rarely develop IE because the endodontic or surgical treatment is already performed (Perez-Chaparro *et al*., 2011; Chen *et al*., 2015).

According to the American Heart Association (AHA) (Wilson *et al*., 2007), triage and treatment of oral infectious foci are essential, not only in patients with high risk of IE but also in patients with intermediate risk. Patients at high risk for IE include patients who have previously had IE, have prosthetic heart valves, complex cyanotic heart disease, or surgically constructed pulmonary shunts, and persistent heart defects in which there is mixing of arterial and venous blood, such as uncorrected ES. Patients at intermediate risk of IE are those with mitral valve prolapse with regurgitation, acquired valvular heart disease, non-cyanotic congenital heart disease, and hypertrophic obstructive cardiomyopathy (Brincat *et al*., 2006).

AHA recommends the use of antibiotic prophylaxis in patients with: Prosthetic Cardiac Valve or Prosthetic Material Used for Cardiac Valve Repair or Other Implantable Cardiac Devices Such as Transcatheter Aortic Valve Implantation, Previous, Relapse, or Recurrent IE, Congenital Heart Disease, and Cardiac Transplant Recipients (Wilson *et al*., 2021).

As the patient in this case report was at high risk of IE due to his uncorrected cardiac ventricular septal defect and was required to undergo multiple endodontic procedures, antibiotic prophylaxis was performed with 2 g of amoxicillin 1 h before all appointments, as recommended by the AHA (Wilson *et al*., 2007). According to the philosophy followed for this case, endodontic instrumentation should be performed only inside the teeth, within their anatomical limits; however, this certainty is somewhat subjective.

In this clinical case, the patient was treated with anticoagulants. Typically, in these patients, dental treatment should be performed without interruption of oral anticoagulant treatment, reducing the risk of secondary thromboembolic complications and helping to limit reluctance by the patient and the cardiologist who accompanies the patient (Andrade, 2007). The patient was using Marevan 5 mg/1d, which was not interrupted for the endodontic treatment and he had no bleeding or thromboembolic complications.

However, the following precautions were taken to prevent bleeding: placement of the isolation clip only on the tooth and without injuring gingival tissue, endodontic instrumentation 1 mm above the apex, care for minor mucosal trauma, as well as careful truncal anesthetic technique with aspiration after puncture and before the injection of the anesthetic.

In general, anesthesia in patients with ES should be strictly based on the number of tubes, and an anesthetic with vasoconstrictor should always be used to reduce pain episodes (Calderón-Ávila *et al*., 2018). Many agents used for the induction and maintenance of general anesthesia depress myocardial function and reduce systemic vascular resistance, with a consequent increase in the magnitude of the right-to-left shunt and cyanosis (Andrade, 2007; Arvanitaki *et al*., 2020). This risk is minimal or unknown in the literature regarding dental anesthesia. This situation can be difficult to reverse and lead to cardiac arrest. According to Vongpatanasin *et al*. (1998) perioperative mortality occurs in up to 20 % of the cases.

Likewise, conscious sedation in outpatients carries the risk of increased hypoxia, which can be difficult to reverse. Therefore, whenever possible, dentists should treat the patients in his office, under local anesthesia; and stress reduction protocols can be useful if necessary. In addition, they must know and follow the clinical safety measures during the care of systemically compromised patients, such as those with ES, considering that good oral health is of fundamental importance for general health.

For safe dental care, the patients with ES must have a recent complete blood test (blood count, blood glucose, and clotting tests according to the drugs used). Antibiotic prophylaxis should be carried out to reduce the risk of IE, and the patient's blood pressure should be measured before starting the appointment and at the end of the treatment, which should be close to normal (120/80 mmHg). It is prudent to provide the patient with oxygen supplementation by catheter and measure the patient's saturation with an oximeter (ideally, the O2 saturation must be maintained above 92 %), keep the patient lying down as little as possible to maintain the respiratory condition without effort, fix brief appointments, avoid intraligamentary and intrapulpal anaesthesia, avoid excessive anesthesia and ideally use only up to two tubes (preferably mepivacaine or lidocaine), and avoid bleeding by placing the isolation clip only on the tooth without injuring the gingival tissue. In this way, safety can be ensured during endodontic procedures.

It is possible to conclude that endodontic treatment is extremely important for the removal of infectious foci in the patient with ES; thus, avoiding complications such as IE of dental origin.

CONCLUSION

Oral complications can seriously compromise the treatment and overall prognosis of patients with ES. In view of this exposure, it is possible to conclude that endodontic treatment is extremely important for the removal of infectious foci in the patient with ES; thus, avoiding complications such as IE of dental origin. Dental Surgeons and cardiologists must work together as a health team to provide quality of life for patients with ES. The collaboration of the families of patients with ES is essential, because the patients need special attention not only in the office but also at home to monitor them between dental appointments.

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RESUMEN: Este reporte de caso tuvo como objetivo describir la importancia del tratamiento endodóntico en la reducción de focos infecciosos en pacientes con síndrome de Eisenmenger (SE) y describir las características del SE, para que el endodoncista pueda tratar con seguridad a estos pacientes. Un hombre de 57 años con ES buscó atención dental quejándose de dolor dental. Se diagnosticó pulpitis irreversible en el diente 37 y necrosis pulpar en los dientes 36, 34 y 31. Se solicitaron pruebas de tiempo de protrombina (PT), tiempo de tromboblastina parcial activada (TTPA) y índice internacional normalizado (INR) para evaluar el perfil de coagulación utilizando Marevan y profilaxis antibiótica con amoxicilina. Se realizaron los tratamientos de endodoncia. Al final, el paciente no refirió dolor ni molestias en los dientes y mejoró la función masticatoria. La eliminación de focos infecciosos orales en pacientes con ES es importante para reducir el riesgo de EI, que podría comprometer gravemente la salud y el pronóstico general del paciente.

PALABRAS CLAVE: Complejo de Eisenmenger, endocarditis, endodoncia, infecciones, calidad de vida.

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