Universidad Europea

GRADUATION PROJECT

Degree in Dentistry

EARLY CARDIOPULMONARY RESUSCITATION IN OUT-OF-HOSPITAL CARDIAC ARREST

Madrid, academic year 2022/2023

Identification number: 94

ABSTRACT:

Introduction: Cardiac arrest is a life-threatening situation that may happen unexpectedly, sometimes during a routine dental procedure. If not addressed immediately, it can result in severe brain lesions and possibly death. Dental professionals are required to understand cardiac diseases and basic cardiopulmonary resuscitation in order to be ready to quickly react in the event of an emergency. Through understanding the potential risks and by being prepared, dentists may have a vital role in preventing and helping to preserve the lives of their patients in the case of cardiac arrest. **Objectives**: The principal aim of this work was to conduct a comprehensive review of the existing literature to determine how an early and correct cardiopulmonary resuscitation in the case of a cardiac arrest happening in the dental clinic, will influence the patient's prognosis. The secondary objectives are to identify the devices, equipment and knowledge that are necessary for the dentist, to lead a safe and secure practice for the patients. Determine the signs and symptoms associated to cardiopulmonary arrest. **Material and methods:** A literature search was carried out in different databases such as Pubmed, Google Scholar, with the use of keywords limited by inclusion and exclusion criteria. **Results:** After applying the established criteria for inclusion and exclusion, a total of 41 outcomes were identified. Following a thorough analysis, 23 studies were ultimately included in this review. These studies investigate the impact of dental practitioners' knowledge on the prognosis of out-of-hospital cardiac arrest cases occurring within the dental clinic setting. **Conclusion:** Early induction of cardiopulmonary resuscitation, recognizing warning signs, and mandatory training in basic life support are key to improve the prognosis of patients undergoing out-of-hospital cardiac arrest. By carrying out these precautions, dental practices can ensure the safety and optimal care of their patients.

Keywords: Dentistry, cardiac arrest, cardiopulmonary resuscitation, basic life support, emergency.

RESUMEN :

Introducción: La parada cardiorrespiratoria es una situación de riesgo vital que puede ocurrir de manera imprevista, a veces durante un tratamiento dental de rutina. Si no se actúa de forma inmediata, puede causar lesiones cerebrales graves y, posiblemente, la muerte. Los dentistas deben conocer las patologías cardiacas y la Reanimación Cardiopulmonar básica para poder actuar con rapidez en caso de emergencia. Al comprender los posibles riesgos y estar bien preparados, los dentistas pueden tener un papel fundamental a la hora de prevenir y ayudar a preservar la vida de sus pacientes en caso de parada cardiaca. **Objetivos:** El objetivo principal de este trabajo ha sido llevar a cabo una revisión amplia de la literatura existente para determinar cómo una reanimación cardiopulmonar precoz y correcta en el caso de que se produzca una parada cardiaca en la clínica dental, influirá en el pronóstico del paciente. Los objetivos secundarios son identificar los dispositivos, equipos y conocimientos necesarios para que el odontólogo pueda llevar a cabo una práctica segura para los pacientes. Determinar los signos y síntomas asociados a la parada cardiorrespiratoria. **Material y método:** Se realizó una búsqueda bibliográfica en diferentes bases de datos como Pubmed, Google Scholar, con el uso de palabras clave limitadas por criterios de inclusión y exclusión. **Resultados:** Tras aplicar los criterios de inclusión y exclusión establecidos, se identificaron un total de 41 resultados. Tras un análisis exhaustivo, finalmente se incluyeron 23 estudios en esta revisión. Estos estudios investigan el impacto de los conocimientos de los odontólogos sobre el pronóstico de los casos de parada cardiaca extrahospitalaria que se producen en el ámbito de la clínica dental. **Conclusión:** La iniciación rápida de la reanimación cardiopulmonar, el reconocimiento de los signos de alarma y la formación obligatoria en soporte vital básico son fundamentales para mejorar el pronóstico de los pacientes que sufren una parada cardiaca fuera del hospital. Al llevar a cabo estas precauciones, los consultorios dentales pueden garantizar la seguridad y la atención óptima de sus pacientes.

Palabras clave : Odontología, parada cardiaca, reanimación cardiopulmonar, soporte vital básico, urgencias.

INDEX

1. INTRODUCTION:

Urgencies and emergencies can be part of the routine for a dental practician. Out of all the critical situations that might happen, we can find the cardiopulmonary arrest.

To face better these situations, the dentist should have some basic knowledge, about heart diseases, and cardiopulmonary resuscitation.

1.1) Definition of cardiopulmonary arrest:

A cardiac arrest is considered as the sudden loss of heart function in an individual, along with the cessation of adequate respiratory function. It can happen in a person that is suffering from a heart condition or not. It is due to a misfunction in the heart's electrical system and happens when the heart stops to beat in a correct way. (1)

It is considered that if no actions are taken, the cardiac arrest can be fatal in the next eight minutes, and severe brain damages might happen after just 5 minutes. In the United States of America (USA), it has been reported that there are more than 350 000 cardiac arrests every year, and around 90% of them are fatal due to the lack of care and fast action. (2)

1.2) Pathophysiology of cardiopulmonary arrest:

During the cardiac arrest, there is a complete cessation of any mechanical activity, that will lead to the blood flow to stop circulating. The vital organs won't receive blood anymore, and thus leading to a decrease in oxygen in these organs. If it remains untreated, it will lead to death (figure1).

Sometimes the respiratory arrest might happen first. In this case, breathing is stopping, if left untreated, it will lead to a cardiac arrest. Indeed, the organs are not supplied anymore in oxygen, and carbon dioxide is not properly removed from the organs leading to an increase of carbonic acid, causing organs damages. (3)

When the cardiac arrest happens unexpected and within a short period of time, it will be considered as sudden. If left untreated, the consequences might be fatal in the worst cases. (4)

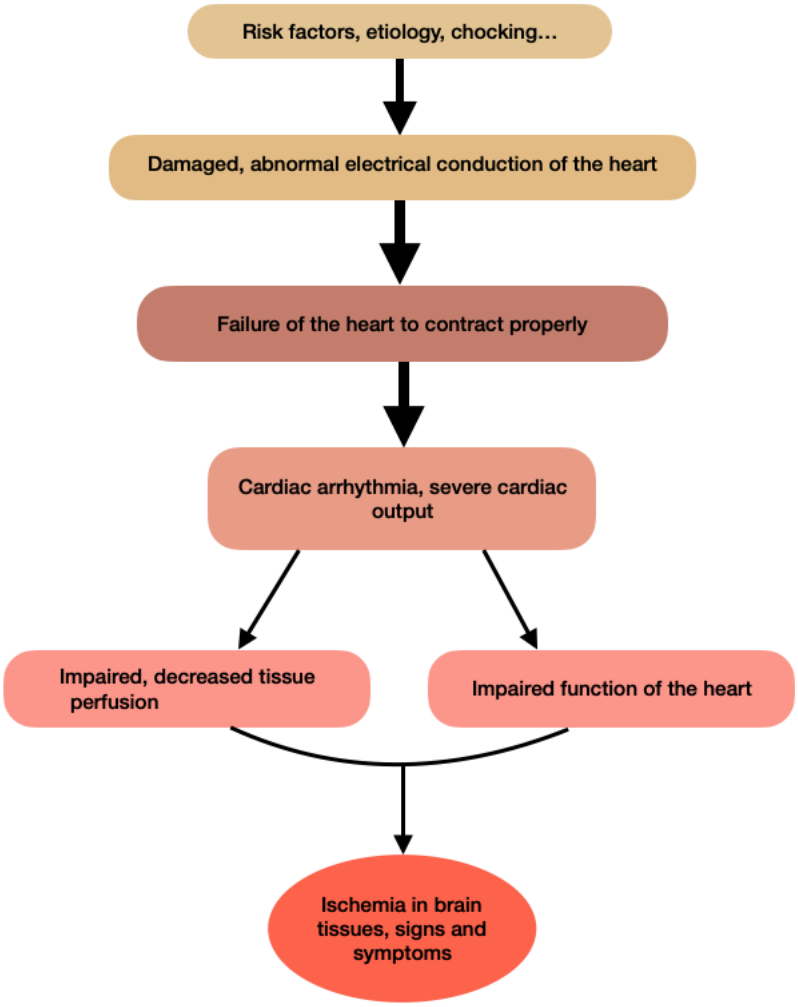


Figure 1: Pathophysiology of a cardiac arrest, (5)

1.3) Etiology of cardiac arrest:

Cardiac arrest can occur for a variety of reasons, and some medical conditions can lead to a sudden cardiac arrest by disrupting the normal electrical activity of the heart, or due to an abnormal respiratory function. There are two types of cardiopulmonary arrests:

- Primary: that are associated to a cardiac cause, intoxication to medicine, or electrocution, and diagnosed using an electrocardiogram:

  - Coronary artery disease: also called ischemic heart disease. It is due to a plaque of cholesterol and other substances, built in the walls of the artery that will cause the narrowing of the arteries thus blocking or reducing the

blood flow to the heart. Symptoms will be chest pain or discomfort, weakness/dizziness, nausea, shortness of breath, pain in the upper limbs, such as left side of the body (arm and shoulder). Over time it might also lead to a weakening of the heart muscle. (6)

- Cardiomyopathy: It is a disease of the heart muscle, causing the heart to become stiff, enlarged, or weakened. The heart loses slowly his ability to pump.(7)

- Congenital arrhythmogenic cardiopathy, it is a rare condition where the heart's structure becomes weak. (8)

- Electrical abnormalities, such as long QT syndrome, might increase the risk for cardiac arrest.

- Ventricular fibrillation, and other heartbeat problems: it is a type of irregular heart rhythm, arrhythmia, affecting the heart's ventricle. It is a malfunction in the heart's pumping capacity. The heart will not pump the blood to the rest of the organs. The beat goes fast and irregular. (9)

- Heart attack: A heart attack occurs when there is a blockage in one of the coronary arteries that supply blood to the heart muscle, leading to damage to the heart muscle and potentially causing cardiac arrest.(10)

- Drug consumption: such as cocaine consumption, that might lead to ventricular fibrillation.

- Intoxication due to medicine: high doses of anesthetics

- Some inherited disorders

- Secondary: it is associated to noncardiac causes, mostly respiratory/pulmonary.

  - Respiratory arrest: due to chocking or anaphylactic chock

  - Obstruction of respiratory tracts

- A trauma to the chest might lead to a cardiac arrest.
- Some physical stress, low oxygen levels, major blood loss, low blood levels of potassium or magnesium, or intense physical activity.
- Hypothermia, that will induce a decrease in heart rate.
- Hemorrhage.(11)

Some people are also more at risk for suffering a sudden cardiac arrest, indeed, the risks increase with the age, it is also more common in men than women, history of heart failure or heart attack. Risk also increases with some diseases such as diabetes, heart blood pressure, chronic kidney failure, or heart failure. (12)

1.4) Diagnostic:

In addition to obtaining a thorough medical history of their patients, dentists should also be able to recognize the signs and symptoms of a sudden cardiac arrest. Indeed, the soonest the diagnosis the better the prognosis. After five minutes, a cardiac arrest might have consequences due to tissue hypoperfusion and cell death, and after eight minutes, with cardiopulmonary resuscitation it can be fatal. Signs and symptoms will happen before a cardiac arrest, and should be diagnosed fast, as a fast action is what is the most important to avoid the cardiac arrest, and the consequences of it. The symptoms happening preceding a cardiac arrest include but are not limited to:

- Weakness,
- Loss of consciousness,
- Hypotension,
- Cyanosis,
- Shortness of breath,
- Chest discomfort,
- No fast beating,

- Palpitations.

Once the cardiac arrest is already established, the most important signs are:

- Unconscious patient
- Not breathing patient
- No pulse

But most of the time they won't be no warning, and the patient will appear with sudden collapse, no pulse, no breathing and then loss of consciousness, this being the most reliable sign of cardiac arrest, when this is observed, the cardiopulmonary resuscitation maneuvers should be initiated to prevent from any possible brain injury. (13)

1.5) Cardiopulmonary arrest happening in the dental clinic:

The best way to avoid any complications associated to a cardiopulmonary arrest is for the dentist to know the patient, the patient's medical history, condition, etc. The fast action is key, and the first way is to know how to behave. The dentist should know about the patients age, medical condition, diseases, history, medication, or allergies, the clinical history is a legal document, that the dentist should be using.

Knowing that the patient suffers from some type of coronary or respiratory pathology, we can shorten their appointments so that they are not in the dental chair for too long, schedule them for the first appointment of the day to avoid waiting and warn them not to stop taking their medication just because they are visiting us (in the case of hypertensive patients, for example). Anticoagulated patients do have to stop taking medication for a certain period of time, depending on the treatment to be performed, following the guidelines of their doctor.(14)

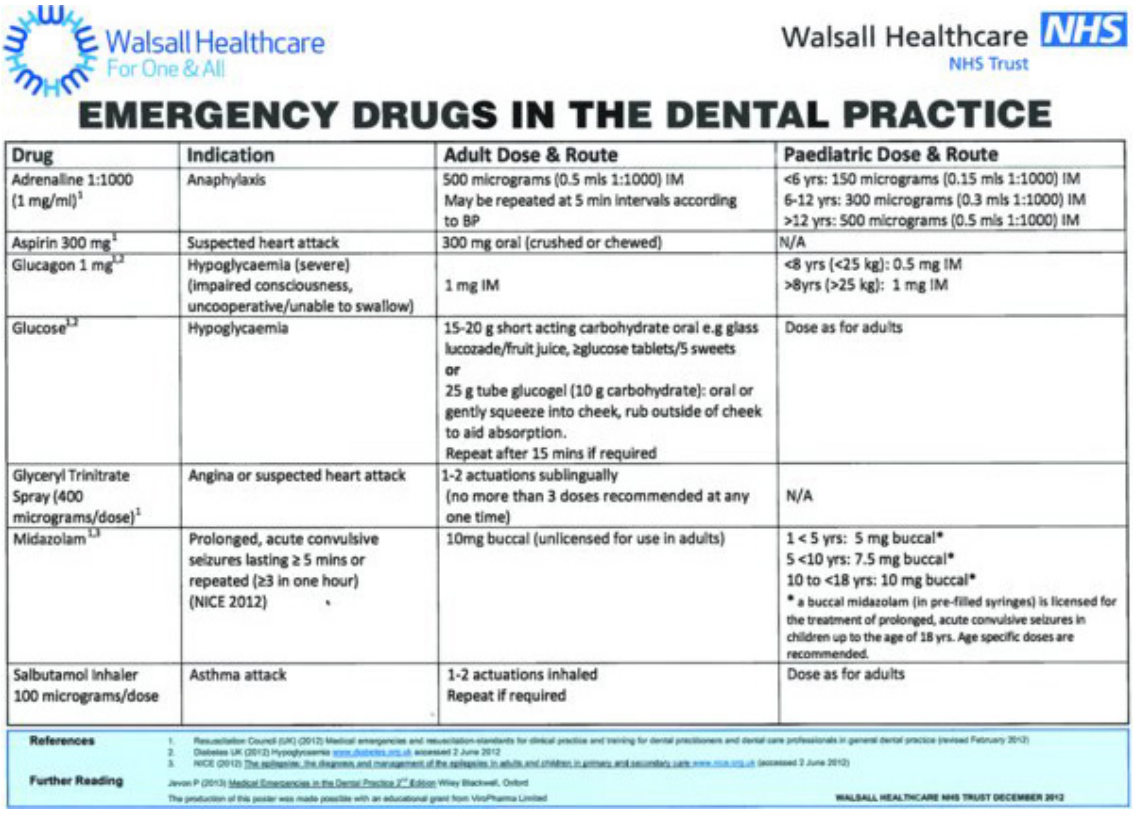
Dentist should be well prepared and updated about the basic life support (BLS) which are the recognition of signs of sudden cardiac arrest, heart attack, stroke, and foreign body obstruction, as much as cardiopulmonary resuscitation (CPR); and defibrillation with an automated external defibrillator (AED).(15) This requires knowledge from the practician but also his team, as much as equipment in the clinic. Being a witness of the

emergency scene, the dentist is the first link in the emergency chain. He should know the signs, allowing early recognition and permitting a fast action giving the alert to the medical care emergency as much as providing the basic first aid.

Beside from the patient's conditions, some things might be triggering for a cardiac arrest in the dental clinic: the patients usually coming stressed, as much as adverse reactions to pharmacology, or also foreign body chocking, in the case where the dentist doesn't or can't use a complete rubber dam isolation. It can also be due to anaphylactic shock, leading to complete breathing obstruction thus a cardiac arrest if not treated fast. Indeed, an anaphylactic shock is a severe allergic reaction that can cause breathing difficulties and ultimately lead to cardiac arrest.(16)

If a patient in a dental clinic is allergic to a particular medication or material used during a dental procedure, it can trigger an anaphylactic reaction. The patient's airway may become constricted, making it difficult to breathe, and they may experience swelling, hives, and a drop in blood pressure. In severe cases, anaphylactic shock can lead to cardiac arrest, so it's important for dental clinics to have emergency protocols in place to recognize and treat anaphylactic reactions promptly (table1). (17)

Table 1: Emergency drugs in the dental practice. (18)



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EMERGENCY DRUGS IN THE DENTAL PRACTICE

Drug	Indication	Adult Dose & Route	Paediatric Dose & Route
Adrenaline 1:1000 (1 mg/ml)[1]	Anaphylaxis	500 micrograms (0.5 mls 1:1000) IM May be repeated at 5 min intervals according to BP	<6 yrs: 150 micrograms (0.15 mls 1:1000) IM 6-12 yrs: 300 micrograms (0.3 mls 1:1000) IM >12 yrs: 500 micrograms (0.5 mls 1:1000) IM
Aspirin 300 mg[1]	Suspected heart attack	300 mg oral (crushed or chewed)	N/A
Glucagon 1 mg[1,3]	Hypoglycaemia (severe) (impaired consciousness, uncooperative/unable to swallow)	1 mg IM	<8 yrs (<25 kg): 0.5 mg IM >8yrs (>25 kg): 1 mg IM
Glucose[1,2]	Hypoglycaemia	15-20 g short acting carbohydrate oral e.g glass lucozade/fruit juice, ≥glucose tablets/5 sweets or 25 g tube glucogel (10 g carbohydrate): oral or gently squeeze into cheek, rub outside of cheek to aid absorption. Repeat after 15 mins if required	Dose as for adults
Glyceryl Trinitrate Spray (400 micrograms/dose)[1]	Angina or suspected heart attack	1-2 actuations sublingually (no more than 3 doses recommended at any one time)	N/A
Midazolam[1,3]	Prolonged, acute convulsive seizures lasting ≥ 5 mins or repeated (≥3 in one hour) (NICE 2012)	10mg buccal (unlicensed for use in adults)	1 < 5 yrs: 5 mg buccal* 5 <10 yrs: 7.5 mg buccal* 10 to <18 yrs: 10 mg buccal* * a buccal midazolam (in pre-filled syringes) is licensed for the treatment of prolonged, acute convulsive seizures in children up to the age of 18 yrs. Age specific doses are recommended.
Salbutamol Inhaler 100 micrograms/dose	Asthma attack	1-2 actuations inhaled Repeat if required	Dose as for adults

References

1. Resuscitation Council (UK) (2012) Medical emergencies and resuscitation-standards for clinical practice and training for dental practitioners and dental care professionals in general dental practice (revised February 2012)
2. Diabetes UK (2012) Hypoglycaemia www.diabetes.org.uk accessed 2 June 2012
3. NICE (2012) The epilepsies: the diagnosis and management of the epilepsies in adults and children in primary and secondary care www.nice.org.uk (accessed 2 June 2012)

Further Reading

Jevon P (2013) Medical Emergencies in the Dental Practice 2nd Edition Wiley Blackwell, Oxford

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1.6) Cardiopulmonary resuscitation:

1.6.1) History:

The cardiopulmonary resuscitation (CPR) is a vital procedure that should be performed in the case of a cardiac arrest. It is a lifesaving procedure, that increase the chances of survival from two to three times. This procedure will help to maintain keeping the blood flow active while waiting for the emergencies to arrive on site.(19)

Table 2: History of CPR (20,21)

Year:	**Method:**
16th century	Creation of the Bellow method, by Paracelsus. A fireplace bellows was used and placed into the nose of a non-breathing patient. The goal was to make air flow again into the patient's lungs.
1732	A surgeon named William Tossach the first mouth to mouth resuscitation on a coal miner. The technique was described as a success.
1775	A veterinarian named Peter Abildgaard realizes experimentation over a dead chicken. The veterinarian shocked him to the chest, restoring a heartbeat.
1856	Introduction of a simple resuscitation technique by a physician named Marshall Hall. No use of ventilation this time. For this technique, we just have to reposition the victim on his side. The aim is to increase chest cavity and add compression on thorax.
1858	A physician named Henry Silvester modifies Hall's technique. This time the patient is laid

	on his back, and his arm is lift above his head.
18th to 20th century	Hall and Sylvester method, artificial respiration
1874	Introduction of heart massages by Moritz Schiff, to restore circulation.
1891	After the introduction of external heart compressions in 1878, by Rudolph Boehm, a surgeon named Friedrich Maass makes history by resuscitating the hearts of two patients, by using chest compression along with respiratory ventilation.
1947	First use of electric defibrillator on a human heart by Claude Beck. The operation was successful.
1956	Mouth to mouth resuscitation is proven to be successful by Dr Elam and Dr Peter Safar. It is the first time in human medicine, that an external defibrillator manages to restore a steady heartbeat in a trembling heart.
1957	First portable external defibrillator
1960	Mouth to mouth resuscitation is now proven useful, it is now used combined with chest

	compression. The name given to this method is “cardiopulmonary resuscitation”, first time it is mentioned in history. The first mannequin, Resusci Ann are produced to allow people to practice CPR (figure 2).
20th century	- Many conferences about CPR - Massive training of the population - Pediatric and neo natal courses are introduced - Public access to defibrillation programs -

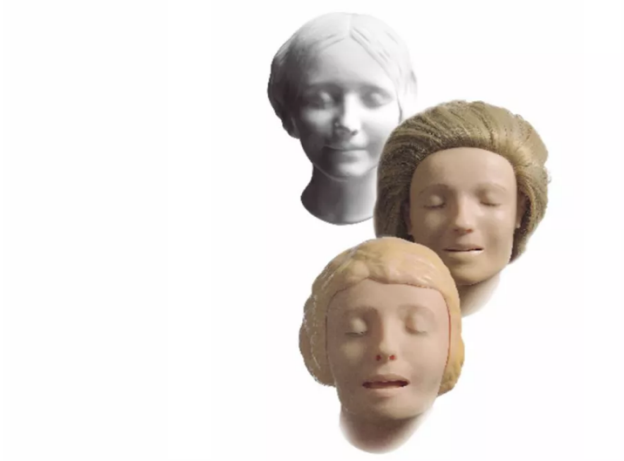


Figure 2: Resusci Anne, the first visage used for CPR training mannequin. It is inspired by the face of a dead teenage girl that was found dead in the Seine, in Paris, in the 19th century. (22)

1.6.2) Definition and uses:

The CPR is part of the chain of survival, a series of action developed and recommended by the American Heart Association in the early 2000s, that should be taken when an out of hospital cardiac arrest happens (figure3). It is composed by:

1) Early recognition of cardiac arrest and access to medical care
2) Early cardiopulmonary resuscitation
3) Early defibrillation
4) Advanced cardiac life support, by medical care services
5) Post cardiac arrest care.
6) Physical and emotional recovery

Figure 3: Out of hospital chain of survival (23)

As stated before, early recognition is vital in the case of sudden cardiac arrest. The dentist should know his patients' medical condition, filling the medical history form and realizing a correct anamnesis in the first visit.

It is advisable to have a series of drugs and devices to deal with emergencies in the dental clinic. The dentist is expected to be able to quickly diagnose these situations, establish appropriate treatment.

There is a list of things that the dentist should know, to prevent from the risk of emergencies to happen, and/or reduce its gravity:

- Correct anamnesis,
- Know the patients' medication,
- Know about drugs interactions,
- Know the patients' allergies,
- Use the minimum doses for anesthetics,
- Have the basic equipment for medical emergencies, such automated electric defibrillator (AED),
- Know the basic cardiopulmonary resuscitation knowledge.

Some people are also more at risk for suffering a sudden cardiac arrest, indeed, the risks increase with the age, it is also more common in men than women, history of heart failure or heart attack. Risk also increases with some diseases such as diabetes, heart blood pressure, chronic kidney failure, or heart failure. (12)

Along with knowing the medical history of his patients, the dentist should also know how to recognize the signs and symptoms of a sudden cardiac arrest, first, might come: weakness, shortness of breath, chest discomfort, and no fast beating, or palpitations. But most of the time they won't be no warning, and the patient will appear with sudden collapse, no pulse, no breathing and then loss of consciousness. (13)

When the heart stops, a fast action is mandatory. First calling emergencies, then starting with the CPR, if the patient is not breathing, we will begin the cardiopulmonary resuscitation (figure 4).

The steps of the CPR are:

- Lay the patient on the back.
- Perform thirty chests compression for two rescue breath.

- It is advised to do a total of a hundred to a hundred and twenty compression in a minute.
- Repeat until the emergency arrives.
- If it is available, use an automated external defibrillator (AED), follow its instructions. (24)
- The most important is to remember CAB: chest compression, airway, breathing.

Figure 4: Step by Step CPR, (25)

The automated external defibrillator (figure 5) is part of the equipment that should be available in the dental clinics. It works by analyzing the electrical activity of the heart. It can recognize the heart stopping, and life-threatening situations, and therefore will give defibrillation. It is very easy to use, as we just need to follow the instructions of the device. Administration of a shock in the first minute following a cardiac arrest has a 90% success rate. (26)

Figure 5: Semi-automatic defibrillator with electrodes (27)

The dentist should also set the dental clinic, with other emergency devices such as medical emergency drugs, medical oxygen, or airway mask bag unit (AMBU) (figure 6).

Figure 6: AMBU (28)

It is very important for the practician and its team to be well prepared; he should always stay updated. As stated before, a fast action is vital in cases as sudden cardiac arrest. Dental workers are expected to be capable of detecting the physical manifestations of sudden cardiac arrest or clinical death, everyone should have basic life support

qualifications as much as equipment in the clinic. The emergency action plan should be known by the team, to ensure a fast acting and give the patient the best chance of survival and recovery, and a minimum of sequels. (29)

In 2022, a study from the American Heart Association revealed that there are more than 356 000 out of hospital cardiac arrest a year in the US, and 90% of them are leading to death. (2)

On a study made in France and Belgium, in 2013, out of 1344 dentists it was found that the incidence of medical emergencies in the dental clinic was of 2.1 events per dentist per year, out of which 0.003 were linked to cardiac arrest. But mostly, this study teaches us that almost one out of five dentists had no emergency equipment in the dental clinic, 66.8% practicians have oxygen, and very few have an automate external defibrillator, 7.7%. 10% of these practicians revealed that were never prepared for medical emergencies. (30)

1.7) Justification:

The aim of this paper is to make an extensive bibliographic review about investigations realized concerning different cardiovascular pathological situations and their management and to reference them. To find out about the basic life support knowledge of the dental practitioners and raise awareness on the necessity of constantly learning and training. Finally, to find out how CPR and fast action might impact the patient's prognosis, and the role the dentist can play in the route to survival to learn better about the equipment that should be available in the dental clinics, there use and the different types of each.

2. OBJECTIVES :

Primary objective:

- Determine how an early and correct cardiopulmonary resuscitation in cardiopulmonary arrest happening in the dental clinic, will influence the patient's prognosis.

Secondary objectives:

- Identify the devices, equipment and knowledge that are necessary for the dentist, to lead a safe and secure practice for the patients.

- Determine the signs and symptoms associated to cardiopulmonary arrest.

3. MATERIAL AND METHODS :

This study is a scientific literature review, conducted in international databases, such as “pubmed”, “medline”, “google scholar”, “researchgate”, also via the service of the university library “CRAI dulce chalcon library” as it permits a free access to documents, scientific journals, etc.

The documents selected were articles published in journal thesis.

The search equation was as follows “cardiac arrest” and “cardiopulmonary resuscitation” and “CPR out of hospital” and “CPR dental clinic” and “emergency in dental clinic” and “CPR and dentist”, using articles in French, English, and Spanish were selected.

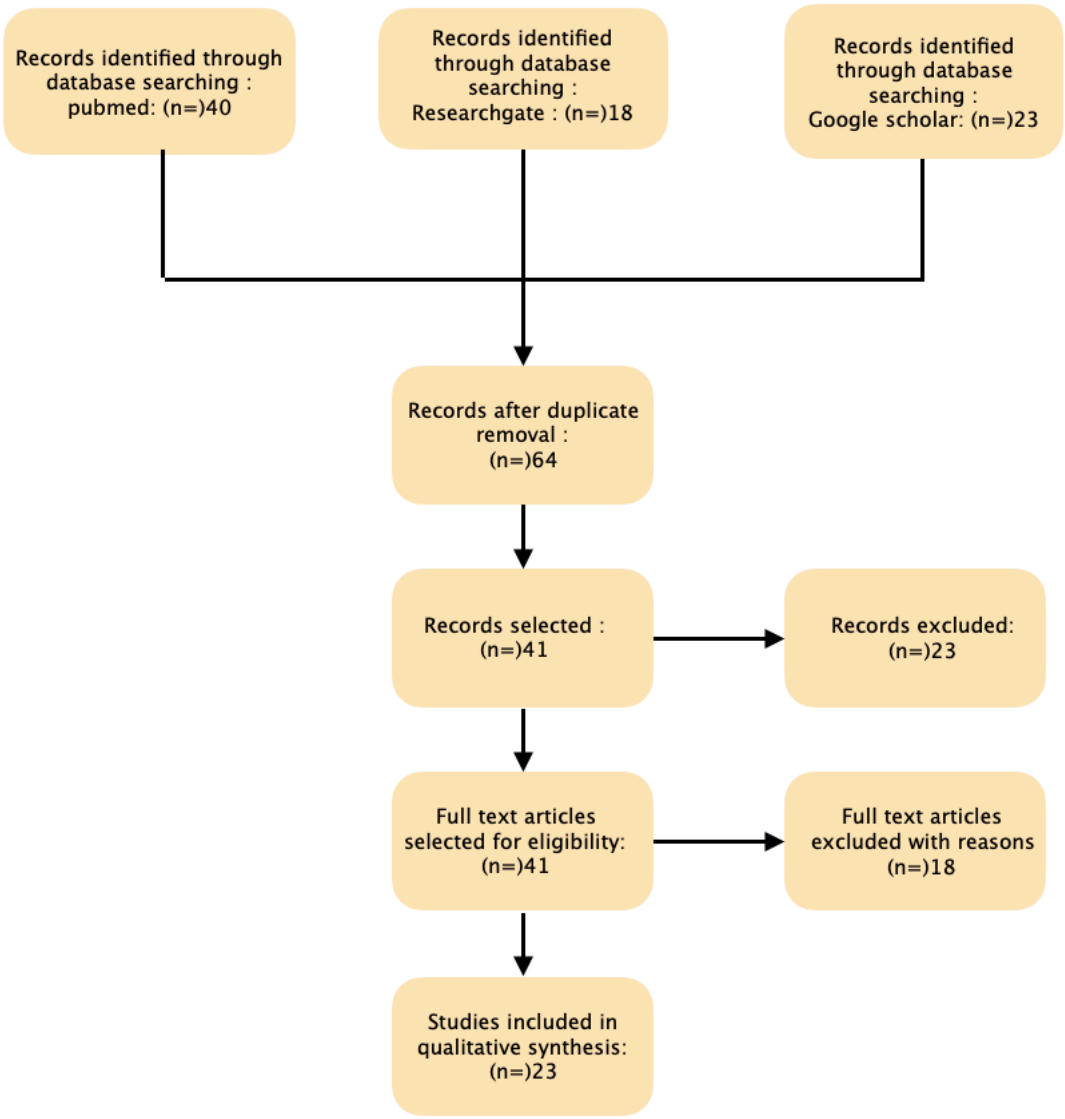
Once all the articles were found through the database, some inclusions and exclusion criteria were used to definitively select the articles.

The exclusion criteria were, articles written before 2010, articles made about CPR or cardiac arrest happening in the hospital, different languages, articles that were recited in different databases, or finally if once reading the full pdf of the article, it was not giving the information sought.

However, the inclusion criteria were articles written from 2010 to 2023, articles helping to understand and answer to the objectives of this essay, as much as studies realized only in humans. An exception was made for articles used to write the introduction, as it was important to understand the history and evolution of this topic.

4. RESULTS :

4.1) Flow diagram :



4.2) Table:

Out of all the articles, 23 have been chosen, they are summarized here: These articles cover a wide range of topics related to cardiac arrest, CPR, and emergency response. Here is a summary of each article:

Table 3 : Results

JOURNAL	AUTHOR	TITLE	TYPE	OBJECTIVE	SUMMARY
International dental journal	Al-Mohaissen MA, Al-Mehisen R, Lee T, Al-Madi EM.	Managing Cardiac Patients: Dentists' Knowledge, Perceptions, and Practices(14)	Survey realized over 282 dentists practicing in Saudi Arabia	To assess the knowledge, and attitude of the dentists, in Saudi Arabia, regarding the management of patients with cardiac conditions	It is important to increase the knowledge of the dentists about cardiac conditions, as many of them thought it was more complicated to manage this type of patients.
Circulation, volume 112, 13 december 2005	AHA/ASA	2005 AMERICAN HEART ASSOCIATION GUIDELINES FOR CARDIOPULMONARY RESUSCITATION AND EMERGENCY CARDIOVASCULAR CARE Part 4: Adult Basic Life Support(15)	Bibliographic review	To summarize the basic life support guidelines, for rescuer and healthcare providers.	This article provides a guideline for performing adult basic life support (BLS) in emergency situations.
J Int Clin Dent Res Organ 2013;5:36-9	Nanavati RS, Kumar M, Modi TG, Kale H	Anaphylactic shock management in dental clinics: An overview(16)	Bibliographic review	To assess a basic knowledge about anaphylactic shock happening in dental clinic	This article gives us an overview about anaphylactic shock happening in the dental clinic. Dentist should be more aware about it, as it is an emergency vital clinical condition.

Br Dent J. 2020 Dec ;229(11):721-728	Jevon P, Shamsi S.	Management of anaphylaxis in the dental practice: an update.(17)	Bibliographic review	To provide an update of the management of anaphylaxis in the dental practice.	This article gives a list of all the risks for anaphylactic shock in the dental practice. The risks in case of misdiagnose, and explains how to handle it, as it can be a life threatening
Br Dent J 229, 97–104 (2020)	Jevon, P.	Medical emergencies in the dental practice poster: revised and updated.(18)	Bibliographic review	To help dental professionals to deal with a medical emergency efficiently and appropriately.	This article gives an update about the types of medical emergencies that can happen in the dental clinic. The basic knowledge the dentist should have and the basic material that should be available in the clinic.
J Am Dent Assoc. 2010 May;141 Suppl 1:14S-9S	Rosenberg M.	Preparing for medical emergencies: the essential drugs and equipment for the dental office.(29)	Bibliographic review	To give information about the training, the knowledge, and the equipment that should be available in the dental practice.	Dentist should have a regular, yearly, actualization about their knowledge about dental emergencies.
Medecine Buccale Chirurgie Buccale. 2014	Laurent, Florian.	Medical emergencies in dental practice.(30)	Survey realized over 25535 French and Belgian dentists.	To know which type of medical emergencies dentist have ever been confronted through their career, and if they were ready to face them at the moment.	Out of the 1344 included dentists, 5 ever experienced a cardiac arrest, 13 the inhalation of a foreign body, 118 a minor allergic reaction and a major allergic reaction, 27 an asthma attack.

					898 claim having oxygen available in the practice, 801 a bag valve mask (AMBU), 116 a defibrillator, 947 say that they have emergency drugs.
National Journal of Maxillofacial Surgery | Vol 5 | Issue 1 | Jan-Jun 2014	Neha Baduni, Prem Prakash, Dhirendra Srivastava, Manoj Kumar Sanwal, Bijender Pal Singh	Awareness of basic life support among dental practitioners (31)	Cross sectional study	To evaluate the knowledge of basic life support out of dental practitioners and students, in New Delhi	None of the people who answered had a complete perfect knowledge about BLS. Only 54% of the participants knew that AED stands for automated external defibrillator. 15.38% know how to assess breathing in an unconscious patient. More than 60% don't know about the correct ratio for chest compression and ventilation in a victim (30:2).
Dental nursing September 2014, Vol10 No 9	Andy Kwasnicki	Cardiopulmonary resuscitation in practice (32)	Bibliographic review	To give information, to the dental practicians about CPR.	This article gives knowledge about CPR and how it should take place in the dental practice. We learn that usually dental practicians are not confident about dealing with medical emergencies. Even though it is something rare, it is still

					important for the dentist to have a basic knowledge as it is important to act fast.
Indian Journal of dental science 08/10/2021	Anagha V. Shete, Mrinal V. Shete, Tejas M. Kulkarni, Avanti D. Chinte, Ashwini Nerkar, Kapil Kshirsagar	Assessment of Level of Knowledge, Awareness, and Attitude toward "Basic Life Support" and "Cardiopulmonary Resuscitation" among Dental Students, Interns, and Dental Practitioners (33)	Survey realized of 256 participants	To assess the level of knowledge on BLS, and CPR over dental students and practicians	It is crucial that dentist have a better and more complete formation about medical emergencies. All of the participants lacked basic knowledge.
British Dental nurses Journal Winter 2016	Ann Clarck	Resuscitation in practice(34)		To explain how to react if the dentist has to manage someday a situation of medical emergency.	
Circulation 2019	Gabriel Riva, Mattias Ringh, Martin Jonsson, Leif Svensson, PhD Johan Herlitz, Andreas Claesson, Therese Djärv, Per Nordberg, Sune Forsberg, Sten Rubertsson, Anette Nord, Mårten Rosenqvist, Jacob Hollenberg,	Survival in Out-of-Hospital Cardiac Arrest After Standard Cardiopulmonary Resuscitation or Chest Compressions Only Before Arrival of Emergency Medical Services (35)	Research article	To confront different types of CPR, while realized before the arrival of emergencies	Patients that were provided a CPR before the arrival of medical emergency services had a greater survival rate and prognosis.

N Y State Dent J. 2006 Jun-Jul	Boyd BC, Fantuzzo JJ, Votta T.	The role of automated external defibrillators in dental practice. (36)	Bibliographic review	To know the importance of using a automated external defibrillator in the dental clinic	The AED is more accessible, thus, by providing training in using it, the dental professionals will be more prepared for emergencies and and will increase their patients' survival in these situations thanks to early defibrillation.
Critical care 2020	Shijiao Yan, Yong Gan, Nan Jiang, Rixing Wang, Yunqiang Chen, Zhiqian Luo, Qiao Zong, Song Chen, Chuanzhu	The global survival rate among adult out-of-hospital cardiac arrest patients who received cardiopulmonary resuscitation: a systematic review and meta-analysis (37)	Bibliographic review	To review the evidence of survival rate in patients who received a CPR in the case of an out of hospital arrest.	The patients receiving a CPR, while waiting for the medical emergency to arrive, have a higher rate of survival.
J Dent Educ. 2007 Apr	Kandray DP, Pieren JA, Benner RW	Attitudes of Ohio dentists and dental hygienists on the use of automated external defibrillators(38)	Survey of 23 questions, realized over random dentists and dental hygienist	Collect data on the management of dentists and dental hygienists in Ohio, of Automated External Defibrillators (AEDs).	With the increase in the probability of facing a cardiac emergency, all dental practice should consider getting and AED. Also considering the fact that dentists are more and more willing to use it and increase their knowledge to deal better with cardiac emergency. During the dental studies, the

					teachers should insist on the importance of these devices and take the time to show how to correctly use them.
Emerg Med J 2016 ;33:448–451.	Gavin D Perkins, Andrew S Lockey, Mark A de Belder, Fionna Moore, Peter Weissberg, Huon Gray	National initiatives to improve outcomes from out-of-hospital cardiac arrest in England (39)	Commentary		To learn about the work and initiative taken in the United Kingdom, to have a population more aware about all the basic life support, and survival chain that should be followed in case of an out of hospital cardiac arrest.
BDJ team 2016	Jevon P.	Resuscitation in the dental practice (40)	Commentary	To make a review of the new resuscitation guidelines.	Provides an overview of resuscitation techniques specific to dental clinics, such as the use of a chair or dental chair for chest compressions and the importance of maintaining airway patency during resuscitation.
Int Dent J. 2013 Dec;63(6):312-6	Marks LA, Van Parys C, Coppens M, Herregods L.	Awareness of dental practitioners to cope with a medical emergency: a survey in Belgium. (41)	Survey, realized over Belgian dentists	To determine if dentists in Belgium feel safe to diagnose and behave when facing an emergency in their everyday practice.	The dentists that receive the more complete and actualize knowledge about CPR are the ones that are feeling the more safe and ready to act fast. Dental practicians

					should have some knowledge about CPR.
Resuscitation (2020)	Jan-Thorsten Gra sner, Jan Wnent, Johan Herlitz , Gavin D. Perkins, …	Survival after out-of-hospital cardiac arrest in Europe (42)	Prospective study, 3 months registering data	To explore outcome of out of hospital cardiac arrest in Europe	
The new england journal of medicine	Ingela Hasselqvist-Ax, Gabriel Riva, Johan Herlitz, Mårten Rosenqvist, Jacob Hollenberg, Per Nordberg, Mattias Ringh, Martin Jonsson, Christer Axelsson, Jonny Lindqvist, Thomas Karlsson, and Leif Svensson	Early Cardiopulmonary Resuscitation in Out-of-Hospital Cardiac Arrest (43)	Research article, analyzing more than 30 000 cases of out of hospital cardiac arrests.		In the cases where CPR was performed before the arrival of the emergency, a survival rate of 30 days was associated. Which is more than two times higher than the cases were no CPR is realized while waiting for the EMS.
BDJ team (2019)	Jevon P.	Management of chocking in the dental practice (44)	Bibliographic review	To give information and knowledge about how to manage a patient chocking while in the dental practice.	This article explains the FBAO (foreign body obstruction), the solutions to deal with it in case it would occur in a dental practice. It also shows the important of basic medical knowledge for the dentist.
	N. Segal, F. Laurent, L. Maman, P. Augustin	Fiabilité d'un dispositif de rétroaction pour guider la réanimation cardio-pulmonaire sur un fauteuil dentaire(45)	Cross sectional study,		

FDI General Assembly: 27-29 September 2021, Sydney, Australia	Basic Life Support (BLS) and Cardiopulmonary Resuscitation (CPR) in the Dental Practice .(46)		to provide recommendations and guidelines for dentists and dental professionals on how to manage medical emergencies in the dental setting, with a specific focus on BLS and CPR	The article highlights the importance of early recognition, effective communication, and prompt response in managing medical emergencies, and provides practical advice on how to prepare for and respond to cardiac arrest, choking, and other medical emergencies in the dental practice.

5. DISCUSSION:

Most of the cardiac arrests happening out of the hospital have a much worse prognosis than when happening at the hospital. To avoid any complications, the fast action is key. The early performance of cardiopulmonary resuscitation (CPR) is crucial to increase the chances of survival in out-of-hospital cardiac arrest patients. Cardiac arrest is a very sudden and unexpected event that can strike at any moment, anywhere and at any age. Life expectancy is significantly increased if CPR is provided within the first few minutes following cardiac arrest. (1,)43) The reason for the importance of early CPR is due to several factors. First of all, rapid CPR will help to sustain the supply of blood to the brain and other vital organs, potentially reducing the amount of harm caused by the cardiac arrest. In addition, well-performed CPR can help restore a healthy heart rhythm, thereby avoiding the complications associated with delayed or inadequate CPR. (4) Lastly, prompt CPR can be conducted by witnesses or healthcare professionals in any venue, including in dental clinics, where patients may experience unexpected cardiac arrests. CPR training is essential to ensure that healthcare professionals are prepared to respond quickly and effectively to emergencies. To conclude, performing CPR early is key to increase the chances of survival in out-of-hospital cardiac arrest patients. Raising the awareness of the importance of early CPR and training healthcare professionals in this resuscitation technique are essential to save lives in emergencies. (23)

When in the dental clinics, many emergency situations can lead to a cardiac arrest, such as anaphylactic shock, patients chocking due to inhalation, history of cardiovascular disease. Indeed, it is necessary for the dental team to be ready and well prepared. In many studies, we find out that a majority of dentist don’t feel safe and secure or confident to face dental emergencies. The dentists that receive the more complete and actualized knowledge about CPR are the ones that are feeling the more safe and ready to act fast, in a study realized in Belgium in 2013 by Marks LA, Van Parys C, Coppens M, Herregods L. to find out about the basic knowledge of dentists regarding medical emergencies, it has been set that dentist should increase there knowledge about medical emergencies(41). This has also been confirmed in a study published in the international dental journal, as the conclusion of this study realized over 282 dentists in

Saudi Arabia, dentist felt like they needed postgraduate formation to learn more about these issues, as the knowledge was suboptimal. (14)

A cardiac arrest in a dental clinic is a rare yet deadly emergency. The outcome of cardiac arrest will depend on many factors, including the reason for the arrest, the time to initiate CPR, the quality of CPR, and the presence of advanced medical care. Studies have shown that providing early CPR and defibrillation considerably enhances the odds of surviving and recovering from a cardiac arrest. Research also shows that the survival rate decreases by 10 percent for each minute of delayed CPR implementation. In the dental clinic, the prognosis of a cardiac arrest can be enhanced by making sure that all the dental team members are educated and prepared to efficiently address a cardiac emergency. Rapid recognition, the activation of EMS, and the initiation of CPR are essential to a better chance of patient survival. While prognosis for cardiac arrest in a dental practice can vary, the dental team may be essential in helping to improve the patient's outcome by making sure they are well prepared to react rapidly and successfully in an emergency scenario. Compared to other cases of out of hospital cardiac arrest, the dental clinic has an advantage. As it is a medical place, it must have some medical devices to face cases of vital emergency. In 2016, the British dental nurse journal diffused an article explaining all the steps and correct behavior to adapt if the dental team faces a case of cardiac arrest. As dentist are supposed to be trained, to face these incidents. The dental team should regularly review and update their emergency protocols to ensure that they are prepared for any emergency that may occur in the dental clinic. (15,18,29,36)

Once we are sure about the diagnosis of a cardiac arrest, it also should be mandatory to have available devices such as: oxygen, AMBU, adrenaline, or also AED, while waiting for the emergency medical service, as using these might impact the prognosis of the patient, for the better. It is admitted that 1/20 will have to realize a CPR at least one time in his career. (46). However, still not enough dentists are aware that they should have these equipment, know how to use them, or work in team, that regularly review and actualize their knowledge and the emergency protocols to make sure they are prepared for any emergency that could happen. Indeed, as stated before the vital emergencies are still rare, so it is not part of the everyday preoccupation for the dental

clinic, for example, in a study, we learn that out of 1344 interviewed, only 116 have a defibrillator available in the clinic(30). However, dentist are usually willing to learn how to use the AED, and increase their knowledge and formation.(38) Finally, to ensure the patient's wellness and security, it would be important to include a medical emergency formation, starting from the young age at the level of dental students, and then actualized yearly, also for the rest of the dental team(29). The biggest obstacle is that dentist don't feel like they know enough, to be comfortable to react the correct way when facing a cardiac arrest. On a study published in the international dental journal, we learn that the majority of the 282 asked dentists, thought it was more complicated to manage patients in a medical emergency state. (14).

Lastly, it is important to state that prevention of medical emergencies should be a priority. Dentist should know about the situations increasing the risks for a cardiac arrest to happen in the dental clinic. For example there is a higher risk for allergic reaction that could possibly lead to an anaphylactic shock, or the inhalation of foreign body, knowing the patient's history. (30)

A combination of prevention, information, and fast action is key. Dentist need an effective training and education, access to necessary equipment and medications, as an early CPR will clearly increase the survival rate in an out of hospital cardiac arrest. (37)

6. CONCLUSION:

Based on a review of the literature and the analysis of several studies, it can be said that the early performance of cardiopulmonary resuscitation is essential for out-of-hospital cardiac arrest, including those in dental clinics. It may significantly enhance the survival and neurologic outcome for the victim. The early minutes following a cardiac arrest are crucial, where immediate CPR may deliver life-saving oxygen to the brain and other vital organs.

Dental professionals are expected to have the necessary training, expertise, and tools to be able to react quickly and effectively in the event of a cardiac arrest in their practice. Basic life support education for all dental professionals must be mandatory to guarantee the health and safety of their patients.

Recognition of the warning signs and symptoms of cardiac arrest is just as important. Recognizing the signs of potential cardiac arrest can allow the dentist and his or her dental team to initiate precautionary measures to reduce the likelihood of it occurring. An early detection and response can drastically improve the patient's prognosis.

In conclusion, this study emphasizes the vital role of an early initiation of CPR, the necessary devices, facilities, and the knowledge required for dentists to assure a secure and safe practice, and the great importance of the recognition of the warning signs and symptoms of cardiac arrest. By applying these precautions, dental clinics can be more fully equipped to handle emergency situations and ensure the optimal care for their patients.

The findings of this review emphasize the essential role of early and efficient CPR in the better outcome of patients suffering from an out-of-hospital cardiac arrest.

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8. ANNEXES :

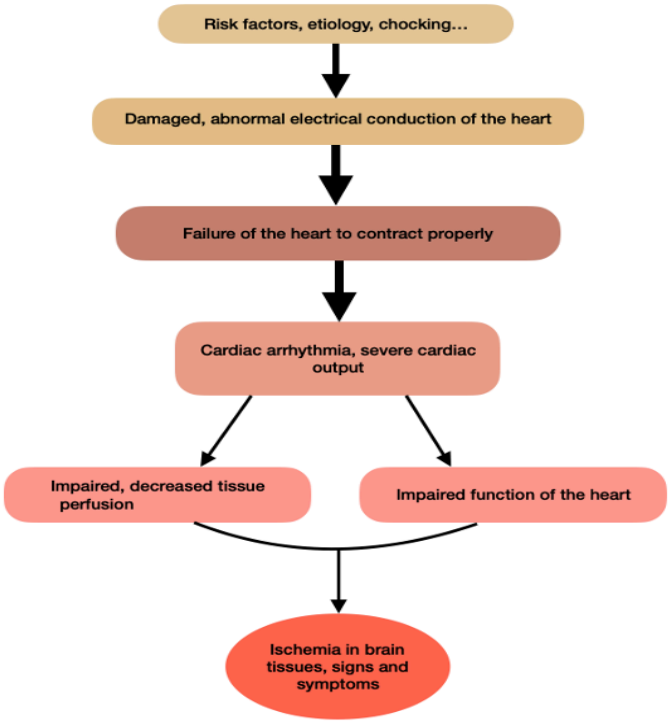

Figure 1: Pathophysiology of a cardiac arrest, (5)

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EMERGENCY DRUGS IN THE DENTAL PRACTICE

Drug	Indication	Adult Dose & Route	Paediatric Dose & Route
Adrenaline 1:1000 (1 mg/ml)[1]	Anaphylaxis	500 micrograms (0.5 mls 1:1000) IM May be repeated at 5 min intervals according to BP	<6 yrs: 150 micrograms (0.15 mls 1:1000) IM 6-12 yrs: 300 micrograms (0.3 mls 1:1000) IM >12 yrs: 500 micrograms (0.5 mls 1:1000) IM
Aspirin 300 mg[1]	Suspected heart attack	300 mg oral (crushed or chewed)	N/A
Glucagon 1 mg[1,2]	Hypoglycaemia (severe) (impaired consciousness, uncooperative/unable to swallow)	1 mg IM	<8 yrs (<25 kg): 0.5 mg IM >8yrs (>25 kg): 1 mg IM
Glucose[1,2]	Hypoglycaemia	15-20 g short acting carbohydrate oral e.g glass lucozade/fruit juice, ≥glucose tablets/5 sweets or 25 g tube glucogel (10 g carbohydrate): oral or gently squeeze into cheek, rub outside of cheek to aid absorption. Repeat after 15 mins if required	Dose as for adults
Glyceryl Trinitrate Spray (400 micrograms/dose)[1]	Angina or suspected heart attack	1-2 actuations sublingually (no more than 3 doses recommended at any one time)	N/A
Midazolam[1,3]	Prolonged, acute convulsive seizures lasting ≥ 5 mins or repeated (≥3 in one hour) (NICE 2012)	10mg buccal (unlicensed for use in adults)	1 < 5 yrs: 5 mg buccal* 5 <10 yrs: 7.5 mg buccal* 10 to <18 yrs: 10 mg buccal* * a buccal midazolam (in pre-filled syringes) is licensed for the treatment of prolonged, acute convulsive seizures in children up to the age of 18 yrs. Age specific doses are recommended.
Salbutamol inhaler 100 micrograms/dose	Asthma attack	1-2 actuations inhaled Repeat if required	Dose as for adults

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Further Reading

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Table 1: Emergency drugs in the dental practice. (18)

Year:	Method :
16th century	Creation of the Bellow method, by Paracelsus. A fireplace bellows was used and placed into the nose of a non-breathing patient. The goal was to make air flow again into the patient's lungs.
1732	A surgeon named William Tossach the first mouth to mouth resuscitation on a coal miner. The technique was described as a success.
1775	A veterinarian named Peter Abildgaard realizes experimentation over a dead chicken. The veterinarian shocked him to the chest, restoring a heartbeat.
1856	Introduction of a simple resuscitation technique by a physician named Marshall Hall. No use of ventilation this time. For this technique, we just have to reposition the victim on his side. The aim is to increase chest cavity and add compression on thorax.
1858	A physician named Henry Silvester modifies Hall's technique. This time the patient is

	laid on his back, and his arm is lift above his head.
18th to 20th century	Hall and Sylvester method, artificial respiration
1874	Introduction of heart massages by Moritz Schiff, to restore circulation.
1891	After the introduction of external heart compressions in 1878, by Rudolph Boehm, a surgeon named Friedrich Maass makes history by resuscitating the hearts of two patients, by using chest compression along with respiratory ventilation.
1947	First use of electric defibrillator on a human heart by Claude Beck. The operation was successful.
1956	Mouth to mouth resuscitation is proven to be successful by Dr Elam and Dr Peter Safar. It is the first time in human medicine, that an external defibrillator manages to restore a steady heartbeat in a trembling heart.
1957:	First portable external defibrillator
1960:	Mouth to mouth resuscitation is now proven useful, it is now used combined

	with chest compression. The name given to this method is “cardiopulmonary resuscitation”, first time it is mentioned in history. The first mannequin, Resusci Ann are produced to allow people to practice CPR (figure 2).
20th century	- Many conferences about CPR - Massive training of the population - Pediatric and neo natal courses are introduced - Public access to defibrillation programs

Table 2: History of CPR (20,21)

Figure 2: Resusci Anne, the first visage used for CPR training mannequin. It is inspired by the face of a dead teenage girl that was found dead in the Seine, in Paris, in the 19th century. (22)

Figure 3: Out of hospital chain of survival (23)

Figure 4: Step by Step CPR, (25)

Figure 5: Semi-automatic defibrillator with electrodes (27)

Figure 6: AMBU (28)