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RESEARCH ARTICLE (ORIGINAL)

Activation of via verde coronária in an emergency room in northern Portugal: A descriptive study

Ativação da via verde coronária num serviço de urgência do norte de Portugal: Um estudo descritivo

Activación de la vía verde coronaria en un servicio de urgencias del norte de Portugal: Estudio descriptivo

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Abstract
Background: Cardiovascular diseases are the primary cause of death worldwide and a significant health concern.
Objective: To describe the number of activations of *via verde coronária* (VVC) in an emergency room (ER) at a hospital in northern Portugal.
Methodology: Quantitative, descriptive, and cross-sectional study of patients admitted to an ER and who had VVC activated between December 2017 and December 2021.
Results: The study sample consisted of 831 individuals, with a majority being men (60.5%). Among them, 45.3% were aged between 61-80 years and 48% had a history of hypertension. The activations were carried out mostly by nurses (98.9%). A significant decrease in the number of activations was observed in 2020, the year of the pandemic. An electrocardiogram was performed within the first 10 minutes in 99.2% of the activations. The most common time of symptom onset was between 6-12 hours. Acute Myocardial Infarction was diagnosed in 11.7% of the sample.
Conclusion: The significant number of VVC activations performed by nurses highlights the importance of their role.

Keywords: myocardial infarction; cardiovascular diseases; emergency service, hospital; epidemiology

Resumo
Enquadramento: A principal causa de morte no mundo são as doenças cardiovasculares, constituindo uma preocupação central em saúde.
Objetivo: Descrever o número de ativações da via verde coronária (VVC) num serviço de urgência médico-cirúrgica (SUMC) de uma unidade hospitalar do norte de Portugal.
Metodologia: Estudo quantitativo, descritivo e transversal, respeitante aos doentes admitidos num SUMC, a quem foi ativada VVC, entre dezembro de 2017 e dezembro de 2021.
Resultados: Amostra de 831 indivíduos, maioritariamente do sexo masculino (60,5%), com 45,3% a integrar o grupo dos 61-80 anos e 48% a apresentar a hipertensão arterial como antecedente patológico. Constatou-se que 98,9% das ativações foram efetuadas pelos enfermeiros. Em 2020 (ano da pandemia), verificou-se um considerável decréscimo no número de ativações. Realizou-se eletrocardiograma nos primeiros 10 minutos em 99,2% das ativações. A hora do início de sintomas com maior predomínio ocorreu entre as 6-12 horas. Diagnosticado Enfarte Agudo do Miocárdio a 11,7% da amostra.
Conclusão: O número elevado de ativações da VVC, efetuadas essencialmente pelos enfermeiros, enfatiza a importância do seu papel.

Palavras-chave: enfarte agudo do miocárdio; doenças cardiovasculares; serviço hospitalar de emergência; epidemiologia

Resumen
Marco contextual: La principal causa de muerte en el mundo son las enfermedades cardiovasculares, que constituyen un importante problema de salud.
Objetivo: Describir el número de activaciones de la vía verde coronaria (VVC) en un servicio de urgencias médico-quirúrgicas (SUMC) de una unidad hospitalaria del norte de Portugal.
Metodología: Estudio cuantitativo, descriptivo y transversal de los pacientes ingresados en un SUMC a los que se les activó la VVC entre diciembre de 2017 y diciembre de 2021.
Resultados: Muestra de 831 individuos, en su mayoría varones (60,5%), con un 45,3% en el grupo de edad de 61-80 años y un 48% con antecedentes de hipertensión. El 98,9% de las activaciones fueron realizadas por enfermeros. En 2020 (año de la pandemia) se produjo un descenso considerable del número de activaciones. Se realizó un electrocardiograma dentro de los 10 primeros minutos en el 99,2% de las activaciones. El momento más frecuente de aparición de los síntomas fue entre las 6 y las 12 horas. Se diagnosticó infarto agudo de miocardio en el 11,7% de la muestra.
Conclusión: El elevado número de activaciones de la VVC, llevadas a cabo principalmente por enfermeros, subraya la importancia de su papel.

Palabras clave: infarto agudo de miocardio; enfermedades cardiovasculares; urgencias hospitalarias; epidemiologia

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Introduction

Cardiovascular disease is the leading cause of death worldwide. In Portugal, diseases of the circulatory system accounted for 28% of deaths in 2020 (Instituto Nacional de Estatística [INE], 2023). Recognizing the severity of a patient's clinical situation is crucial when they are admitted to the emergency department (ER) of a hospital. In Portugal, the Manchester triage system (MTS) was introduced on 15 October 2000, based on the English version published in 1997. The MTS helps prioritize patients based on the severity of their condition. The MTS methodology involves identifying the patient's initial complaint and following the corresponding decision flowchart. The best flowchart is selected based on the patient's main complaint. The MTS categorizes the patient into one of six classes, identified by a number, name, color, and target time for initial observation. The patient's priority level is indicated by a color code: emergency (red), very urgent (orange), urgent (yellow), low urgent (green), standard (blue), and non-urgent (white), with no time set for observation. The patient is seen immediately if they are emergent, can wait up to 10 minutes if they are very urgent, up to one hour if they are urgent, up to two hours if they are low urgent, and up to 4 hours if they are non-urgent (Grupo Português de Triagem, 2010). In 2007, a fast-acting protocol called *via verde coronária* (VVC) was implemented (Lima et al., 2021) to reduce mortality associated with acute myocardial infarction (AMI). The National Institute of Medical Emergency has coordinated the implementation of VVC throughout the country, enabling patients suffering from acute heart disease to access appropriate medical care earlier (Carapeto, 2012). The triage nurse plays a fundamental role in identifying signs and symptoms and activating VVC as they are the first health professionals to come into contact with the patient. Nurses must be competent in decision-making during triage. They should prioritize necessary care based on appropriate decision-making using the initial assessment (Smith & Cone, 2010).

The main objective of this study is to describe the number of VVC activations in an emergency room (ER) in northern Portugal between December 2017 and December 2021.

Background

The VVC "is an organized strategy for efficiently managing and treating serious clinical situations during the pre-, intra-, and inter-hospital phases. It is crucial for the health of the population" (Direção-Geral de Saúde, 2015, p. 69). Ermida (2018) states that the VVC approach to AMI aims to minimize the time between symptom onset and treatment initiation to promote the most suitable reperfusion strategy. The time between symptom onset and reperfusion determines the size of the damaged myocardium, which affects morbidity and mortality. AMI, also known as Acute Coronary Syndrome (ACS), refers to the irreversible death of heart muscle tissue due to a sudden decrease or total interruption in blood supply to a certain area of the heart (Thygesen et al., 2019). The primary symptom of suspected ACS is chest pain. An electrocardiogram (ECG) is crucial in the diagnosis of ACS (Collet et al., 2020). The ECG analysis differentiates two types of patients: those with acute chest pain and persistent ST-segment elevation lasting more than 20 minutes, and those with acute chest pain but without persistent ST-segment elevation. ST-segment elevation ACS (STEACS) typically indicates an acute total coronary occlusion. The main treatment for most patients with STEACS is immediate reperfusion through primary angioplasty or fibrinolytic therapy (Thygesen et al., 2019). In STEACS, ECG changes may include transient ST-segment elevation, T wave inversion, flat T waves, or pseudo normalization of T waves or normal ECG. Patients who do not meet the criteria for myocardial infarction can be diagnosed with unstable angina. Unstable angina is myocardial ischemia that occurs at rest or with minimal exertion and does not involve acute cardiomyocyte injury or necrosis. It is characterized by prolonged angina (lasting more than 20 minutes) at rest, new onset of severe angina, progressive angina (more frequent, longer duration, or lower threshold), or angina occurring after a recent episode of AMI (Byrne et al., 2023). Coronary artery disease may not show any symptoms (Meira et al., 2021). The primary symptom of ACS is chest pain, which is typically felt as pressure or heaviness behind the breastbone and may radiate to the left arm (less commonly to both arms or the right arm), neck, or jaw. The pain may be intermittent or constant and may be accompanied by cold sweats, nausea, abdominal pain, or lightheadedness (Collet et al., 2020).

Bourbon et al. (2019) state that cardiovascular diseases are linked to modifiable and non-modifiable risk factors. Non-modifiable risk factors include heredity, gender, and age. Modifiable risk factors can be changed through lifestyle measures and medication. The main cardiovascular risk factors are high blood pressure (HBP), smoking, stress, diabetes, and dyslipidemia. Prevention is crucial. According to a literature review by Ribeiro et al. (2020), patients who experienced an AMI commonly had two or more risk factors present simultaneously. This suggests that the presence of multiple risk factors increases the likelihood of an ischemic event. ACS is a critical event that requires early recognition, rapid stabilization, and appropriate treatment for the patient. According to Ribeiro (2020), response time is a determining factor in maintaining or losing myocardial contractility. Ornelas et al. (2023) conducted a study in the Autonomous Region of Madeira and found 1,376 VVC activations in the ER in 2020, 1,601 in 2021, and 1,834 in 2022. Chest pain was the main symptom for VVC activation in 91% of the sample.

Research question

What is the number of VVC activations in an ER in a hospital in northern Portugal?

Methodology

This study is a quantitative analysis of patients admitted to the ER of a hospital in northern Portugal between December 2017 and December 2021 who had VVC activated. A data collection grid was used, based on scientific literature and relevant information extractable from existing clinical records. The questionnaire aimed to gather sociodemographic and clinical information about the patient, including age, gender, and medical history. Additionally, the sample was described in terms of the number of VVC activations by year, month, day, and hour, as well as the time of symptom onset, arrival at the ER, priority given in the MTS, reason for activation, ECG results, medication administered, diagnosis, and patient destination.

The time of symptom onset and arrival at the ER were classified into four categories: [0-6h[, [6-12h[, [12-18h[, and [18-24h]. Since there was no information available on the time of symptom onset, a new category was added, defined as *no information*. It also included details on triage priority, reason for activation, ECG results, anti-ischemic medication (acetylsalicylic acid/clopidogrel/ticagrelor), fibrinolytic medication, final diagnosis, and patient destination. Two nurse specialists in Medical-Surgical Nursing analyzed the form and approved it. The ethics committee had previously given a favorable opinion (opinion no. 7/2023), and the Chairman of the Board of Directors of the hospital unit where the study took place authorized it. The department appointed a person in charge to hand over the anonymized data, ensuring data confidentiality. We analyzed the data with IBM SPSS Statistics for Windows software (version 26.0). Then, we conducted a descriptive statistical analysis by calculating absolute and relative frequencies.

Results

Table 1 presents the sociodemographic and clinical characteristics of the sample. The sample consisted of 831 patients, with the majority being male (60.5%; *n* = 503). The age distribution was as follows: 15.2% (*n* = 126) were aged 81 or over, 21.1% (*n* = 175) were aged 71-80, 24.2% (*n* = 201) were aged 61-70, 18.3% (*n* = 152) were aged 51-60, 12.2% (*n* = 102) were aged 41-50, and 9% (*n* = 75) were aged 40 or under. In the sample, 48% (*n* = 399) had a history of HBP, followed by 31.8% (*n* = 264) with previous heart disease and 20.8% (*n* = 173) with diabetes. Additionally, 16.7% (*n* = 139) were obese, 7.6% (*n* = 64) had heart failure, and only 0.1% (*n* = 1) had undergone recent surgery.

Table 1

Sociodemographic and clinical characterization of the sample

Sociodemographic and clinical variables		***n***	**%**
Gender	Female	328	39.5
	Male	503	60.5
Age group	81 years and older	126	15.2
	71-80 years	175	21.1
	61-70 years	201	24.2
	51-60 years	152	18.3
	41-50 years	102	12.2
	40 years and younger	75	9
Total		831	100%
Antecedentes patológicos	High blood pressire	399	48
	Previous heart disease	264	31.8
	Diabetes	173	20.8
	Obesity	139	16.7
	Heart failure	63	7.6
	Recent surgery	1	0.1

Note. *n* = Absolute frequency; *%* = Relative frequency.

Table 2 displays the number of VVC activations categorized by year, month, day, time of symptom onset, time of arrival at the ER, priority assigned in the MTS, reason for activation, ECG, administration of medication, diagnosis, and patient destination.

The majority of VVC activations occurred in 2019 (32.3%; *n* = 268), followed by 2018 (29.7%; *n* = 247) and 2021 (27.8%; *n* = 231). In contrast, 2020 experienced the most significant decrease in the number of activations (9.2%; *n* = 77). VVC was most frequently activated in January (10.2%; *n* = 85) and December (10%; *n* = 83), followed by May (9.4%; *n* = 78). March, June, and July had similar activation rates, with 8.6% (*n* = 71), 8.2% (*n* = 68), and 8.3% (*n* = 69), respectively. February had the lowest activation rate (6.1%; *n* = 51).

The day with the highest number of activations was

Monday, accounting for 17% (*n* = 141) of the total. In contrast, Saturday had the lowest activation rate at 10.3% (*n* = 86). Wednesday had 139 activations (16.9%), while Tuesday had 130 (15.6%). Thursday and Friday had similar activation rates with 122 and 116 respectively. Sunday had an activation rate of 11.7% (*n* = 97).

Symptom onset occurred mostly between 6-12 hours (25.4%; *n* = 211), followed by the period between 12 and 18 hours (23.1%; *n* = 192). In the 0-6 hour period, 16.2% (*n* = 135) of the sample experienced symptoms that led to VVC activation.

Concerning arrival time at the ER, 37.2% (*n* = 309) sought help between 12-18 hours, 26.6% (*n* = 221) between 18-24 hours, 24.1% (*n* = 200) between 6-12 hours, and 12.1% (*n* = 101) were admitted to the ER between 0-6 hours.

According to the MTS classification, orange was the predominant priority (97.3%; *n* = 808), followed by yellow (2.3%; *n* = 19), and red and green (0.2%; *n* = 2). The triage nurse carried out 98.9% (*n* = 822) of VVC activations.

Patients most commonly complained of nonradiating chest pain (50.4%; *n* = 419), followed by chest pain (35.4%; *n* = 294). Out of the 104 participants, 12.5% reported epigastric pain, while only 1.7% reported sudden dyspnea.

The ECG was performed within the first 10 minutes for 99.2% (*n* = 825) of the sample, with 85.9% (*n* = 714) of these patients not taking anti-ischemic medication and only 0.7% (*n* = 6) undergoing fibrinolysis.

The final diagnosis revealed that 11.7% (*n* = 97) of the patients had AMI, and 5.4% (*n* = 44) had unstable angina.

Table 2

Sample distribution by activation of Via Verde Coronária, time of symptom onset, time of arrival at the emergency department, priority assigned in the Manchester triage system, primary/secondary activations, reason for activation, electrocardiogram performed, medication, diagnosis, and patient destination

Variables		*n*	%
Year	2017 (December)	8	1
	2018	247	29,7
	2019	268	32,3
	2020	77	9,2
	2021	231	27,8
Month	January	85	10,2
	February	51	6,1
	March	71	8,6
	April	68	8,2
	May	78	9,4
	June	68	8,2
	July	69	8,3
	August	63	7,6
	September	55	6,6
	October	75	9
	November	65	7,8
	December	83	10
Days of the week	Monday	141	17
	Tuesday	130	15,6
	Wednesday	139	16,7
	Thursday	122	14,7
	Friday	116	14
	Saturday	86	10,3
	Sunday	97	11,7
Time of symptom onset	[0-6h[	135	16,2
	[6-12h[	211	25,4
	[12-18h[	192	23,1
	[18-24h]	147	17,7
	No information	146	17,6

Time of arrival at the emergency room	[0-6h[	101	12,1
	[6-12h[	200	24,1
	[12-18h[	309	37,2
	[18-24h]	221	26,6
Manchester triage system – priority assigned	Red	2	0,2
	Orange	808	97,3
	Yellow	19	2,3
	Green	2	0.2
Primary/secondary activations	Primary (performed by the triage nurse)	822	98.9
	Secondary (performed by the doctor)	9	1.1
Reason for activation	Non-radiating chest pain	419	50.4
	Chest pain	294	35.4
	Epigastric pain	104	12.5
	Sudden dyspnea	14	1.7
Electrocardiogram performed	0-10 minutes	824	99.2
	More than 10 minutes	7	0.8
Medication	Anti-ischemic (acetylsalicylic acid/clopidogrel/ticagrelor)	117	14.1
	Fibrinolytic	6	0.7
	Did not take anti-ischemic/fibrinolytic medication	708	85.2
Diagnosis	Acute myocardial infarction	97	11.7
	Unstable angina	44	5.4
	Others	690	82.9
Patient destination	Discharge	568	68.4
	Observation room – Emergency room	110	13.2
	Transferred to another hospital unit (with a hemodynamic laboratory)	104	12.5
	Inpatient service	41	4.9
	Intensive care unit	3	0.4
	Death	5	0.6
Total		831	100%

Note. n = Absolute frequency; *%* = Relative frequency.

Discussion

The study sample mainly consisted of men aged 61 to 70 years old. Silva et al. (2020) conducted a retrospective study to identify the main risk factors in patients with AMI. The sample included 155 patients, with a predominance of men (55.5%) and 51% of the sample belonging to the 60-79 age group. HBP was the most common pathological antecedent in this study, as in previous studies by Ermida (2018) and Silva et al. (2020). HBP, the main risk factor for cardiovascular disease, increases with age and affects 71% of Portuguese people aged 65-74 (Ministério da Saúde, 2018). The year with the highest number of VVC activations was 2019 (32.3%). The number of activations decreased sharply in 2020, possibly due to lower demand for health services resulting from the pandemic. Urgent and emergency services were also used less in 2020 and 2021 due to health measures and reduced movement of people to control the COVID-19 pandemic (Administração Central do Sistema de Saúde [ACSS], 2022). January and December had the highest number of VVC activations. Patients meeting VVC activation criteria mostly sought after Monday. According to Rocha and Silva's (2020) study, hospitalizations for cardiovascular diseases and AMIs peaked on Mondays (19.3%). The weekly distribution of hospitalizations followed this pattern.

Symptom onset is more common in the morning, between 6 am and 12 noon. Llerena et al. (2020, p. 63) explain that this fact is due to the "joint action of endogenous and exogenous factors. Endogenous factors include the morning increase in cortisol, catecholamines, blood pressure, heart rate, and vascular resistance. Exogenous factors include changes in the sleep-wake cycle, standing, and beginning of activity". Most patients experienced symptoms between 6 am and 12 noon. However, the majority of patients sought the ER during the 12-18 hour period. In the case of AMI, the time between symptom onset and blood flow restoration in the myocardium is critical to the prognosis. Treatment within the first 6 hours is optimal, as after 12 hours, mortality reduction is negligible (Thygesen et al., 2018).

The MTS assigned a predominance of the color orange (97.3%), with only 2.3% of the sample being assigned the color yellow. These results support Castro's (2021) study, which found that 64.6% of patients were triaged as orange priority, 32.9% as yellow priority, and 2.5% as green priority. Similarly, Souza (2020) reported that 81.8% of patients were assigned orange priority in the MTS.

Regarding the reason for VVC activation, 50.4% of VVC activations were due to chest pain described as radiating pressure or heaviness behind the sternum, 35.4% of patients reported nonradiating chest pain, 12.5% reported epigastric pain, and only 1.7% reported sudden or isolated dyspnea.

Ornelas (2023) found chest pain to be the primary symptom of VVC activation. Castro (2021) found that 83.5% of individuals experienced chest pain, 3.8% experienced vomiting, 2.5% experienced syncope, 3.8% experienced interscapular pain, and 2.5% experienced abdominal pain. Souza (2020) reported that chest pain was the primary complaint of patients (84.4% of the sample), followed by malaise (4.8% of the sample).

In 99.2% of cases where the VVC was activated, an ECG was performed within the first 10 minutes of screening. This supports the findings of Francisco et al (2022), where 85.97% of patients diagnosed with AMI underwent ECG within the recommended time frame of 10 minutes according to cardiology guidelines. The ECG is essential in the assessment of ACS and should be performed within the first 10 minutes of contact with the patient, whether in a prehospital or hospital setting (Meira et al., 2021). According to the ESC guidelines for the diagnosis and management of ACS, ECG interpretation should take no more than 10 minutes (Collet et al., 2020).

Only 14.1% of the sample received anti-ischemic medication, and just 0.7% underwent fibrinolysis. Thrombolytic therapy aims to dissolve the thrombus that is blocking the artery responsible for the infarction and should be administered as soon as possible after the onset of pain. Time is critical in preserving the myocardium. The possible risks of this treatment remain consistent over time, but the benefits decrease significantly as time passes. The maximum benefit is achieved when reperfusion therapy is administered within the first hour after the onset of pain (Collet et al., 2020). Reperfusion therapy is crucial in the treatment of ST-segment elevation MI. Infusion therapy can reduce mortality rates, especially when administered within the first hour of symptom onset. The time between symptom onset and treatment initiation is a crucial factor affecting prognosis. Among patients activated for VVC, 11.7% were diagnosed with AMI, and 5.3% were diagnosed with unstable angina. In their study, Lima et al. (2021) concluded that 60.7% of patients diagnosed with a cardiac event were activated VVC. Of these patients, 60% were diagnosed with ACS and 22% with unstable angina.

The established diagnosis determines the most appropriate destination for the patient's clinical situation. Out of the sample, 68.4% were discharged, 13.2% were admitted to the emergency observation room, 12.5% were transferred to another hospital unit, 0.4% required admission to intensive care, and 0.6% passed away. Lima et al. (2021) found that 53.6% of the sample were transferred to a Basic Health Unit, 27.2% were hospitalized, 11.2% were referred to a specialist consultation, 6.2% were transferred to another hospital unit, and 1.5% died.

The nurse plays a crucial role in avoiding myocardial injury, from screening to early recognition of ACS and activating VVC. This study showed that 98.9% of activations were carried out by nurses. Meira et al. (2021) emphasize the importance of addressing cardiovascular risk factors with the patient and their family after stabilizing the patient's acute situation. They highlight the benefits of healthy lifestyles.

The results do not allow for generalizations due to the study type (descriptive) and spatiotemporal context of the data.

Conclusion

In 2020, there was a significant decrease in activations due to the pandemic. The triage nurse was responsible for most VVC activations in this study. The nurse, as the first healthcare professional to come into contact with the patient, plays a crucial role in the timely detection and knowledge of the person with AMI and the consequent activation of VVC. Health professionals and the public in this region should be made aware of the higher incidence of AMI in the morning and the importance of promptly seeking medical care. Analytical studies should be conducted across wider geographical areas and include a greater range of variables. For example, how patients access the ER.

Author contributions

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