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REVIEW ARTICLE

Out of hospital cardiac arrests and aortic dissection

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ABSTRACT

INTRODUCTION: Out of Hospital Cardiac Arrest (OHCA) is one of the main causes of death worldwide. Most of the intrinsic causes of OHCA tend to be of cardiac origin, however, non-cardiac etiologies such as acute aortic dissection (AAD) may be more common than previously thought. The aim of this focused review is to summarize current knowledge on the association between OHCA and AAD.

METHODS: A systematic review was previously performed on the incidence of AAD in the context of OHCA. For this publication, the selected references were reviewed to address three pre-determined questions: 1) How prevalent is Acute Aortic Dissection in Patients presenting with Out of Hospital Cardiac Arrest? 2) What clinical signs are associated with OHCA due to Acute Aortic Dissection? 3) How can we treat these patients and what is their prognosis?

RESULTS: AAD may cause OHCA due to several reasons, such as retrograde involvement of the coronary arteries, aortic valve insufficiency, pericardium tamponade, aortic rupture, massive stroke, visceral malperfusion or hypertensive induced heart failure, for example. Since both the treatment and diagnosis of acute aortic dissections have improved, a growing number of OHCA due to AAD patients have been diagnosed and managed, however, the epidemiology and outcomes of these patients are still not fully understood.

Keywords: Out of Hospital Cardiac Arrest; Aortic Dissection; Review [Publication Type]

INTRODUCTION

Out of Hospital Cardiac Arrest (OHCA) is defined as "the loss of functional cardiac mechanical activity in association with an absence of systemic circulation, occurring outside of the hospital".[1] The true incidence of this event is unknown as a significant number of patients die on site before any medical assistance arrives, however, in Europe, the estimated incidence of people with all-rhythm OHCA treated by emergency medical services is 37.72 per 100.000 person-years, and only around 10.7% survive the event.[2]

OHCA causes may be divided in two main groups, intrinsic and extrinsic causes.[1,3] Extrinsic causes may be due to drug overdose, trauma, suicide, drowning and dehydration for example and will not be the scope of this review.[1,3] Intrinsic causes may further be divided into cardiac and non-cardiac causes.[1] Most are due to cardiac causes, such as acute coronary syndromes, arrythmias, cardiomyopathies and valvular heart diseases. However, non-cardiac intrinsic causes may also occur, such as acute aortic dissections.[3] Acute aortic dissections (AAD) may cause OHCA due to a number of reasons, such as retrograde involvement of the coronary

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arteries, aortic valve insufficiency, pericardium tamponade, aortic rupture, massive stroke, visceral malperfusion or hypertensive induced heart failure, for example.[3,4]

Since both the treatment and diagnosis of acute aortic dissections have improved, a growing number of OHCA due to AAD patients have been diagnosed and managed, however, the epidemiology and outcomes of these patients are still not fully understood.[4] In this review we aim to discuss and analyze the epidemiology of OHCA due to AAD and their outcomes.

METHODS

We have recently performed a systematic review and meta-analysis of the incidence of aortic dissection in patients with OHCA.[4] For the purpose of this focused review study, the same references were reviewed and summarized to answer three pre-defined questions: 1) How prevalent is Acute Aortic Dissection in Patients presenting with Out of Hospital Cardiac Arrest? 2) What clinical signs are associated with OHCA due to Acute Aortic Dissection? 3) How can we treat these patients and what is their prognosis?

RESULTS

How prevalent is Acute Aortic Dissection in Patients presenting with Out of Hospital Cardiac Arrest?

In our previous study[4] we found that 4.39% of intrinsic OHCAs were due to AAD. If only studies with type A AAD were included, this frequency was even higher, being about 7.18%, and if we included studies in which every patient had access to imaging diagnostic methods, the frequency increased to 8.27%. Overall studies varied from 0.64% to 11.44%.[4-6] This means that AAD is more common in patients with OHCA than previously thought with between 1/10 to 1/20 of these patients having an AAD. When looking at subtypes of AAD, type A dissections were far more common, which is expected seeing as they may evolve more frequently to retrograde involvement of the coronary arteries, aortic valve insufficiency, pericardium tamponade, aortic rupture and massive stroke.4 Some studies have also reported AAD as a cause for OHCA in younger patients. In these studies the frequency of AAD as cause for OHCA was 1.12%.[4] This may be related to patients with connective tissue disease, although further studies are needed to correctly address this question.

The fact that so many cardiac arrests are due to dissections is not surprising seeing as it is a common presentation in AAD. In a recent study analyzing all admitted type A aortic dissections, 33% of patients presented with cardiopulmonary arrest.[7]

What clinical signs are associated with OHCA due to Acute Aortic Dissection?

Takeuchi et al performed a study looking at patients with OHCA who were submitted to CT imaging. In their study 7.6% of patients with OHCA had an acute aortic dissection, most with type A aortic dissections. When compared to type A dissections that did not arrest, they found that OHCA patients tended to be older and present with massive bloody pericardial effusion or intrathoracic hemorrage.[3]

The initial diagnosis of AAD in OHCA patients may be challenging. Patients with aortic dissection tend to have the same age and risk factors as other causes of cardiac arrest.[8] Furthermore, the typical initial symptom of type A aortic dissections tends to be anterior chest pain, similar to that of a myocardial infarction.[9,10] However, there are some clinical signs of AAD which are not so common in other conditions, such as asymmetrical pulses between the four limbs and aortic insufficiency murmur, although, these are sometimes difficult to assess in a patient under cardiac arrest maneuvers.[9,10] The most important thing is to understand that AAD is a common cause of OHCA and therefore, imaging methods should be undertaken to understand the etiology of the cardiac arrest.[3,11]

How may we diagnose these patients in a timely manner?

Since the only way to accurately and timely diagnose an AAD is with imaging techniques, when managing patients with OHCA, one must decide what is the best timing for this diagnosis and which method to choose. The ideal and gold standard imaging would be to perform a Computed Tomography Angiography (CTA),[9,10] however, since many patients do not recover enough to perform this exam, another option is either a transesophageal echocardiography or non-contrast induced CT.[3,11]

Takeuchi et al[3], showed that the use of non-contrast induced CT in this setting is simple and convenient and may accurately diagnose these patients. This has also been supported by other studies[12,13], and has been shown to be easier in older patients with calcified aorta, as the CT may show an inward shift of the calcification.[14,15] This radiological sign may be applicable in reality since most AAD patients are not young. In a recent systematic review of the incidence of AAD in population-based studies, the mean age for AAD varied between 58.9 and 77.3 years.[8] In the study by Takeuchi et al, the mean age of patients with OHCA due to AAD was 78 (± 8) years.[3]

Another possibility is to use transesophageal echocardiography, which may be helpful in diagnosing AAD, especially type A aortic dissections.[11] It may also be performed while resuscitative maneuvers are being applied, which is an advantage over the CT. Kim et al[11] have applied this strategy and reported their outcomes in a cohort of 45 patients with OHCA. In this study they found that 10 (22%) patients who did not have return to spontaneous circulation after >10 min of cardiopulmonary resuscitation had an AAD.[11] Although a selection bias may have existed since they excluded a significant number of patients from the study due to logistical reasons, this number is quite impressive. Additionally, it further proves the applicability of this method if one has access to trained personnel in the emergency department who can perform this diagnostic method.

How can we treat these patients and what is their prognosis?

Since most of AAD leading to OHCA are type A aortic dissections, the most important action is timely diagnosis and aortic repair. Type A aortic dissection is a surgical emergency, and survival is directly linked to the ability to repair the aorta as fast as possible.[9,10,16]

However, studies analyzing the survival of patients with OHCA due to type A aortic dissection have shown a daring scenario, with survival close to 0% in most studies.[4] This has led some authors to question what to do after the diagnosis of AAD is made in case of a patient presenting with OHCA, with some supporting simply stopping any resuscitative maneuvers and accept mortality as a certain outcome.[4] Some studies, however, have differed from this and have shown that some patients can in fact survive.[3,17] Tanaka et al, reported a survival rate of 11.1% in patients with AAD and OHCA. Although they do not go in depth into their mortality results, timely diagnosis, and rapid depressurization in cases of pericardial effusions may be related to the better outcomes. Takeuchi et al[3] also report a 4.2% survival rate. A recent study has also looked at the outcome of type A aortic dissections presenting with cardiopulmonary arrest.[7] In their study they found that aortic repair may be performed with a 30% likelihood of functional recovery if return of spontaneous circulation is achieved.[7] In all other studies we found a reported 100% mortality rate.[4,6,11,18-20] These discrepancies in survival rates may be due to varying reasons, like different definitions of OHCA and study designs. However, both these studies with survivals have come from Japanese centers, and report the use of fast-track access to CT imaging.[3,17] Timely diagnosis and surgical repair probably due have an impact in mortality and may save at least some of these patients. It is not surprising that both these studies reported incidences of AAD higher than other studies, probably due to better diagnosis methods.[3,4,17]

Furthermore, critical care in Japan has evolved significantly in the past years with an excellent pre-hospital care and interconnection between trauma and emergency centers.[21] An interesting concept introduced a few years ago have been the hybrid emergency rooms.[22] These rooms are located in the emergency department and are fully equipped with CT, angiography C-Arms, ultrasounds and an operating table.[22-28] These rooms make it possible to perform in the same location, the initial assessment, immediate diagnosis and immediate surgery or endovascular procedures if needed.[22-28] One can imagine how these hybrid rooms may change the outcomes for patients with AAD and OHCA in which time is of the essence. They have also been shown to significantly reduce the time needed for surgical management of acute situations as well as lowering the need for blood transfusion products and, in addition, have shown to be cost effective.[22-29] Furthermore, these rooms have been replicated in the West and also shown to be effective.[28,29] Loftus et al[29], analyzed their outcomes after implementing the hybrid emergency room and compared it to historical controls, finding that it was associated with earlier hemorrhage control, fewer early blood transfusions, infectious complications and ventilator days.

Future studies and directions:

Currently, we know that AAD is a common cause of OHCA, probably even higher than what is reported since most patients are not submitted to imaging analysis. We also know that non-contrast CT imaging and transesophageal echocardiography may be useful as a rapid diagnosis tool. Current results following AADs presenting with OHCA have been daring, with a mortality of 100% in most studies, putting into question if we should even attempt to resuscitate. However, more timely diagnosis and repair might be a solution to at least save some of them. The use of hybrid emergency rooms, higher disease awareness and quick access to surgical repair may be a way forward. More studies analyzing these options are needed to better understand the viability and possible options in treating these patients.

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