Review Article
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Concurent Cardio-Cerebral infarction: definition, diagnosis, causes and treatment

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Abstract

Acute ischemic stroke and acute coronary syndrome are the major conditions causes of death worldwide. The prevalence of coronary artery disease has been reported in one fifth of stroke patients. The concurent cardio-cerebral infarction defiend if this two conditions occures at the same time or one after the other within several hours. In this review we describe the definition, causes and treatment of the concurent cardio-cerebral infarction

Keywords: Concurent cardio-cerebral infarction, definition, causes, treatment

Introduction

The incidence of acute ischemic stroke (AIS) after acute myocardial infarction (AMI) during the hospital stay ranges from 0.7% to 2.2% [1-3]. Acute ischemic stroke occurred more frequently in the first days after AMI, but incidence progressively decreased over time [4-5]. Brandi Witt et al, suggested that during hospitalization for the acute myocardial infarction (MI), 11.1 ischemic strokes occurred per 1000 MI compared with 12.2 at 30 days and 21.4 at one ear. Positive predictors of stroke after MI included: advanced age, diabetes, hypertension, history of prior stroke, anterior location of index MI, prior MI, atrial fibrillation, and heart failure [6]. The incidence of AMI after acute ischemic stroke was relatively low and unexpectedly highest during the first year after stroke. The 5-year cumulative incidence of AMI was 2.0%. The annual risk was highest in the first year after the index event (1.1%), followed by a much lower annual risk in the second to fifth years (between 0.16% and 0.27%). Coronary heart disease was the most substantial risk factor for AMI after stroke and conferred an approximate 5-fold greater risk [7]. Both AIS and acute myocardial infarction are medical emergency conditions, which require timely diagnosis and management. The incidence of patients who diagnosed acute ischemic stroke about 0.009% [8]. In this article we describe the definitionş causes and treatment options of the concurent cardio-cerebral infarction. Definition of concurent cardio-cerebral infarction: Concurent Cardio-cerebral infarction can generally be defined as primary disorders of heart or brain often result in secondary infarction/injury to the both organs either at the same time or one after the other within 12 hours.

Diagnosis of concurent cardio-cerebral infarction:

1. AIS (a sudden onset of focal neurological deficit caused by an acute focal injury to the central nervous system due to a vascular narrowing cause)
2. AMI (acute elevation cardiac enzyme plus ischemic electrocardiogram and/or symptoms).
3. The two conditions at the same time or one after the other within 12 hours.

Pathophysiology of concurent cardio-cerebral infarction:
The pathophysiology of simultaneous cardio-cerebral infarction can be classified into three categories:

(1) Cardiac conditions Type 1A: There are several conditions that lead to simultaneous acute cerebral and coronary infarction. The most of these is atrial fibrillation has been reported as a cause of simultaneous cardio-cerebral infarction due to common source of both cerebral and coronary embolism [9]. Type-I acute aortic dissection with dissection flap extending to coronary and common carotid arteries origin had been reported to

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cause concurrent acute myocardial infarction and acute ischemic stroke [10]. In addition, concurrent coronary and cerebral vasospasm due to electrical injury have been reported as an uncommon cause of simultaneous cardio-cerebral infarction [11].Pre-existing intracardiac thrombus from left ventricular tumour or prosthetic valve thrombosis or impaired left ventricular ejection fraction can also lead to simultaneous coronary and cerebral vascular occlusion [12]. The thrombus formed in the right ventricle in acute right ventricular infarction with right ventricular dysfunction in combination with patent foramen ovale can embolize to both vascular territories. Severe hypotension or cardiogenic shock following AMI can also lead to hemodynamic stroke [13].

(2) Brain causes (Brain–heart axis) Type 1B: Brain–heart axis dysregulation might be an alternative pathophysiology of simultaneous cardio-cerebral infarction syndrome. It has been shown that the insular cortex plays a critical role in central autonomic system regulation [14]. Patients with AIS in the parietoinsular region were found to have higher risk of developing arrythmias such as atrial fibrillation [15]. An abnormal electrocardiogram, including ST-segment elevation myocardial infarction, was found to be related to ischemic stroke in the insular cortex [16]. In addition to electrocardiographic abnormalities, myocardial damage determined by elevated serum cardiac troponin T was shown to be associated with acute cerebral infarction in specific brain regions including the right insular and right inferior parietal lobule [17]. Cardiac sympathetic overactivity from an insular cortex lesion can provoke diffuse myocardial damage, "myocytolysis," which leads to elevation of cardiac enzyme [18]. Results from human studies showed that the stimulation of different sides of the insular cortex resulted to different cardiac autonomic responses. And the right-side stimulation of insular cortex resulted in a predominant sympathetic effect, whereas the left-side stimulation resulted in a predominant parasympathetic effect [18]. (3) Non cardiac and non-brain causes: Type 1C: Coronavirus disease 2019 (COVID-19) infection and Type I cardio-cerebral infarction syndrome: Recent studies suggested that coronavirus disease 2019 (COVID-19) infection can be increased the risk of AIS and AMI. However, the evidence base is limited mainly to case reports and two cohort studies. The evidence that COVID-19 may increase the risk of acute ischemic cardiovascular events. the underlying mechanisms may cytokine-mediated hypercoagulability and plaque destabilization [19]. Severe hypotension can be causes infarction in brain and myocardial infarction. Table 1 suggested the causes of concurent cardiocerbral infarction [20]. The causes of concurent cardio-cerebral infarction: multiple causes of cardio-cerebral infarction erer reported, the most common is atrial fibrilation and left ventricle thrombus, other causes such as aortic dissection, COVID 19 infection, Polycythemia, malignancy and patent foramen ovale were reported (Table 1)

Table 1: The causes of concurent cardio-cerebral infarction

Causes	Examples
Left heart thrombus	Atrial fibrilation, left ventricle thrombus, left atrial myxoma, infective endocarditis.
Atherosclerotic	Uncontrolled hypertension, smoking, diabetes mellitus and previous coronary arterydisease
Hyper coagulant states	COVID 19 infection, Polycythemia, malignancy and patent foramen ovale
Hypotensive	cardiogenic shock and severe heart failure.
Mechanical complication	aortic dissection

Treatment: According to the 2018 scientific statement guideline from the American Heart Association/ American Stroke Association (AHA/ASA), For patients presenting with synchronous AIS and AMI, treatment with intravenous alteplase at the dose appropriate for acute ischemic stroke, followed by the percutaneous coronary intervention (PCI) and stenting if indicated, is reasonable [21]. The new recommendation according to 2021 guidelines of the European Stroke Organization (ESO) on intravenous thrombolysis for acute ischemic stroke suggested that [22]: Contraindication of alteplase for patients with acute ischemic stroke of < 4.5 hours duration and with history of subacute (> 6 h) ST-segment elevation myocardial infarction during the last seven days. The intravenous alteplase also has contraindications in patients with acute ST elevation myocardial infarction with recent acute ischemic stroke if the stroke duration is more than 4.5 hours from the onset of symptoms . So that if AIS after 6 hours from STEMI onset, or STEMI after 4.5 hours from AIS intravenous alteplase is a contraindication. In these conditions, we recommended intervention treatment with percuataneous coronary intervention (PCI) ans mechanical thrombectomy (MTE). (Figure 1)

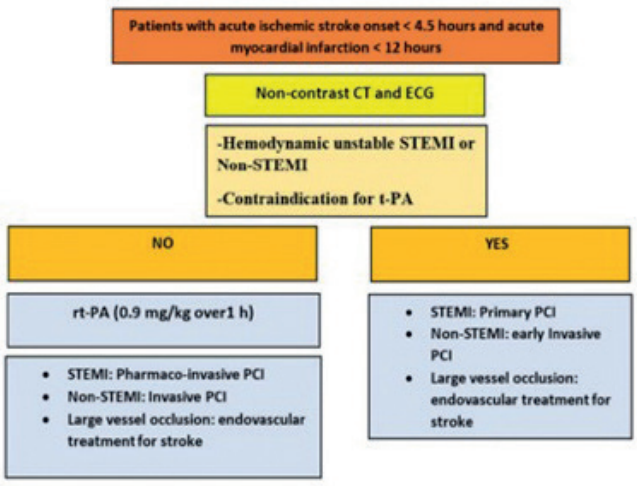

Figure 1: Treatment of concurent cardio-cerebral infarction syndrome.

First presentation AMI or AIS ; Habib et al, suggested that 53% of patients presented with acute ischemic stroke symptoms followed by acute myocardial infarction symptoms. In this patient, the most common MI type was inferior MI. Acute myocardial infarction symptoms followed by acute ischemic stroke symptoms were reported in 20 % of the patients. In this group, the most common stroke type was anterior circulation with the right middle cerebral artery or right internal carotid artery occlusion. At the same time presentation of myocardial infarction and acute ischemic stroke symptoms was occurred in 27% patients. [20]. For alteplase medication, only 44% of patients were treated with intravenous alteplase, percutaneous coronary intervention (PCI) was used to treat 31% of patients Mechanical thrombectomy of cerebral vessels in were administrated in 25% of the patients. Only 22% of the patients were treated in combination with both PCI and Mechanical thrombectomy of cerebral vessels. [20].

Discussion

The causes of concurrent cardiocerebral infarction reported into five types: 1. Embolic (left ventricle thrombus in patients with previous myocardial infarction or dilated cardiomyopathy, left atrial appendage thrombus in patients with atrial 6ibrillation). 2. Hypotensive (patients with cardiogenic shock and heart failure). 3. Atherosclerotic (patient with hypertension, smoking, diabetes mellitus and previous coronary arterydisease). 4. Hyper coagulant states (COVID 19 infection, Polycythemia, malignancy and patent foramen ovale) 5. Mechanical complication (aortic dissection). The left ventricular systolic dysfunction and atrial fibrillation are increasing the likelihood of embolic stroke due to thrombus formation in the left ventricle and left atrial appendage. These two phenomena have been commonly reported in this analysis.

The main concerns about giving alteplase to patients with AIS and a history of recent MI are (Beyond the bleeding): 1. Thrombolysis-induced myocardial hemorrhage predisposing to myocardial wall rupture. 2. Possible ventricular thrombus that could be embolized because of thrombolysis. 3. Post-myocardial -infarction pericarditis may become hemopericardium.

The mortality rate showed that concurrent cardiocerebral infarction had a high during hospital admision 33 % and after three months mortality rate was 49 %. The in-hospital mortality rate was higher in males (35%) than in females (18.9%) and 78% of death related to cardiovascular causes. [20].In metanalysis of 44 patients, ten patients died (23%) and nine (90%) of those were due to cardiac causes [23].

Conclusion

The occurrence of concurrent cardio cerebral infarction is rare with high risk of mortality rate especially in female patients. The rate medical treatment with thrombolytics and percutaenous intervention treatment with PCI and MTE was low. Further studies will need to examine the optimum treatment strategies

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