Cognitive Decline and Dementia in Common Cardiac Disorders

Subjects: Neurosciences

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Acute and chronic cardiac disorders predispose to alterations in cognitive performance, ranging from mild cognitive impairment to overt dementia. Dysregulated and persistent inflammatory processes have been implicated as potentially causal mediators of the adverse consequences on brain function in patients with cardiac disease.

neuroinflammation | cognitive impairment | dementia | myocardial infarction | heart failure | hypertension | coronary artery disease | atrial fibrillation

1. Introduction

Acute myocardial infarction (MI) is the leading cause of morbidity and mortality worldwide. It affects about 16 million patients every year [1] and predisposes not only to chronic heart failure (HF) [2], but also to an accelerated cognitive decline beyond ageing. Not only MI and HF, but also other common cardiac disorders such as hypertension, atrial fibrillation (AF) and coronary artery disease (CAD) markedly increase the risk for developing mild cognitive impairment (MCI), vascular cognitive impairment and dementia (VCID), and Alzheimer's dementia (AD) [3][4]. Due to the ageing population and an increase in the number of patients with cardiac diseases, these sequelae are of great relevance as they impact both morbidity and quality of life on the side of patients and their relatives, and healthcare costs on the side of society [5].

2. Myocardial Infarction and Coronary Artery Disease

There is now consolidated evidence for an accelerated cognitive decline after MI [3][4]. The Rotterdam Study reported on 4971 individuals in whom a prior history of MI was associated with worse cognitive performance, independent of age and education [6]. Further analysis revealed an increased risk of dementia and a higher degree of cerebral small vessel disease in people with unrecognized MI [7]. Likewise, the Bronx Aging Study studying 488 subjects observed a five-fold increased risk of developing dementia when patients with a history of MI were compared to those without [8]. Consistently, an accelerated cognitive decline was observed only after and not prior to the occurrence of MI in the English Longitudinal Study of Ageing with 7888 patients [9]. Recurrent non-ST elevation MI was independently associated with cognitive decline after one year of follow-up in the "Improve cardiovascular outcomes in high-risk older patients" (ICON-1) study in 211 patients [10]. A history of MI doubled the risk for MCI or probable dementia in the Women's Health Initiative Memory study in 6455 cognitively intact, postmenopausal women [11]. Likewise, in the Italian Longitudinal Study of Aging, a history of MI was associated with an increased risk of progression from MCI to dementia among 2963 participants [12]. Interestingly, in a huge Danish nationwide population-based cohort study with 314,911 patients with MI and 1,573,193 matched comparison cohort members, MI predicted a greater risk for VCID, but not for AD [13].

Cognitive decline beyond ageing also affects people with CAD. In a small Californian study including 74 subjects, CAD was associated with a greater decline in global cognition, verbal memory, and executive function [14]. Zheng et al. found that the presence of atheromatosis in coronary vessels positively correlated with cognitive dysfunction [15]. The rate of memory decline among older adults with CAD seems to be similar between groups of patients undergoing coronary revascularization with coronary artery bypass grafting or percutaneous coronary intervention [16]. Of note, some data also point towards the reversibility of the process of cognitive decline, e.g., 43 patients with CAD who were treated with a statin and weekly in-hospital aerobic exercise for 5 months improved their Mini-Mental State Examination (MMSE) score [17]. In addition, lower cardiovascular health predicted late-life decline in cognitive function among high-risk CAD patients [18].

3. Heart Failure

Chronic HF is a complex clinical syndrome that often coexists with multiple comorbidities. MCI appears to be a particularly important condition in HF [19], although reports on its prevalence vary between 25% and 75% across population-based studies due to variation in definitions and diagnostic criteria [20][21][22][23][24]. Patients with HF typically exhibit MCI in the domains of memory, working memory, attention, processing speed, and executive function [22][25]. In patients with HF, MCI was shown to significantly increase the risk of hospitalization and mortality, and decrease quality of life [19]. Chronic HF is also associated with an increased risk of dementia and AD in older adults [26]. On the contrary, a Danish nationwide population-based cohort study found that chronic HF was associated with an increased risk of all-cause dementia, but not AD [27]. Thus, there is no consensus as to whether HF may also increase the risk of AD. Impaired cognition in people with chronic HF was reported to relate to hypertension, daytime sleepiness, stress, and poor quality of life [28]. In this regard, type 2 diabetes was shown to accelerate MCI and significantly reduce the executive ability of elderly patients with chronic HF [29]. In contrast to chronic HF, MCI in acute HF remains frequently unrecognized, since there are still many unresolved issues regarding cognitive changes in patients hospitalized with acute HF [30].

4. Hypertension

Hypertension has been shown to be a risk factor for both AD and VCID, as indicated by several epidemiologic studies [31]. Cerebral infarcts, lacunae, and white matter changes are implicated in the pathogenesis of VCID, but may also favor the development of AD [32]. A recent investigation including 90 individuals found that hypertensive participants revealed more deficits in skills involving delayed recall and prefrontal-region skills [33]. Likewise, the greatest impact on cognitive function in those with hypertension appears to be on executive or frontal lobe function, similar to the area most damaged in vascular dementia [34]. In a large Chinese study with 2413 individuals, it was reported that hypertension diagnosed during mid-life was associated with worse cognition compared to that diagnosed in late life [35]. Managing and controlling blood pressure could thus preserve cognitive function, e.g., by reducing the risk of VCID or stroke [36].

5. Atrial Fibrillation

According to a recent meta-analysis including 2,415,356 individuals, AF is linked to an increased risk of incident dementia and cognitive decline [37] (random-effect hazard ratio 1.36). Further, prospective observational studies have shown that AF increased the risk of stroke, an important cause of cognitive impairment, although the association between both conditions may well be independent of stroke and other shared risk factors [38]. Along these lines, incidental AF was associated with an increased risk of both early and late-onset dementia, independent of the occurrence of clinical stroke [39]. Interestingly, the use of oral anticoagulants and successful catheter ablation were associated with a decreased risk of developing dementia [40]. In a post hoc sub analysis of the Systolic Blood Pressure Intervention (SPRINT) trial, processing speed was the most prominent cognitive domain affected by AF. Potentially, this property might help with screening for early signs of cognitive dysfunction [41]. Several markers indicative of atrial cardiomyopathy, a structural and functional disorder of the left atrium, such as increased brain natriuretic peptide and left atrial enlargement, were also associated with an increased risk for cognitive impairment [42].

6. Aortic Valve Stenosis

Comprehensive neurocognitive assessment unmasked advanced cognitive impairment in patients with severe aortic stenosis planned for transcatheter aortic valve replacement (TAVR) [43]. Interestingly, the mere presence of aortic valve calcification in computer tomography was not associated with cognitive impairment in any cognitive test, nor any measure of global cognition [44]. There is now also evidence that TAVR may improve cognitive functions that depend on cerebral perfusion, especially of the hippocampus in elderly patients with severe aortic stenosis [45]. Such preservation or improvement of cognition after TAVR is particularly encouraging, as this population is characterized by a rapidly declining cognitive trajectory set in motion by ageing [46].

7. Cardiac Arrest

After cardiac arrest, the initial survival of patients is limited by brain death and severe neurological damage, either mandatorily (in the case of brain death) or potentially (in the case of severe damage and corresponding presumed patient wish) [47]. Cognitive dysfunction, in particular memory problems, is frequent amongst survivors of out-of-hospital cardiac arrest [48], e.g., cognitive impairment four years after cardiac arrest was present in more than one-quarter of patients [49]. Cohort studies demonstrated a high prevalence (54.4%) of long-term cognitive deficits and functional limitations in cardiac arrest survivors [50], even in those with apparently favorable neurological recovery [51]. While early systematic testing of cognitive performance is recommended by the current post-resuscitation guidelines, such concepts are infrequently implemented [52].

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