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Ischemic Stroke after CABG and Embolic Stroke of Undetermined Source: A Case Report

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Abstract

One of the complications seen after coronary artery bypass graft operation (CABG) is ischemic stroke. In recent years, "embolic stroke of undetermined source" (ESUS) has been defined as a subtype of ischemic stroke. In this study, a 49-year-old patient with a history of preoperative ischemic stroke and recurrent ischemic stroke after CABG is presented. The necessity of a detailed evaluation of preoperative stroke risk factors and the importance of determining stroke etiologies are discussed in the context of ESUS, which is a new subtype.

Keywords: CABG, acute ischemic stroke, stroke, ESUS, ischemic heart disease

Introduction

Acute ischemic stroke (AIS) that develops after coronary artery bypass graft operation (CABG) can cause serious clinical consequences that can lead to death. Symptomatic stroke after CABG has been reported at a rate of 2-3%[1]. Ischemic stroke is caused by reduced blood flow to the brain due to a thrombotic or embolic process. In embolic processes, embolic residues originate from any part of the body (especially cardiac origin) prevent blood flow in the vascular area where they are located. The etiology of stroke affects both prognosis and results[2].

In this article, a 49-year-old male patient with diabetes mellitus (DM), hypertension (HT), smoking, ischemic

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heart disease (IHD), and a history of previous stroke (HPS) developed AIS on the fourth postoperative day after CABG. The necessity of detailed assessment of stroke risk factors before cardiac surgery and the importance of identifying stroke etiologies are discussed in the context of a new stroke etiological subgroup, embolic stroke of undetermined source (ESUS).

Case Report

The 49-year-old male patient had DM for 15 years, HT for 10 years, has been smoking for 25 years/pack, had neovascular glaucoma for 5 years, and HPS (partial anterior circulation infarction) 3 months ago. Body mass index was calculated as 25.2. While investigating the etiology of stroke, IHD was detected and coronary angiography was performed. A stent was placed in the left anterior descending (LAD) after determining chronic occlusion in the LAD and right coronary artery (RCA). It was observed that the stent in the LAD was obstructed, the circumflex artery had plaque, and the RCA was totally occluded in the angiography performed upon the presence of effort dyspnea while being monitored under medical treatment (Figure 1). The transthoracic echocardiography report showed an ejection fraction of 35%, wall motion defects in the apical, mid, and basal regions, 1st degree mitral regurgitation, 1st degree tricuspid regurgitation, and pulmonary artery pressure of 30 mmHg. In myocardial perfusion scintigraphy performed for living tissue research, areas with perfusion defects and metabolic activity (viable tissue) were observed in the areas with defects. It was decided to perform CABG with the decision of Cardiology and Cardiovascular Surgery Council.

In preoperative analyses, hemoglobin was 12.7 g/dL, creatinine 1.4 mg/dL, eGFR53 mL/min, HDL 26 mg/dL, LDL 44 mg/dL, cholesterol 115 mg/dL, and HbA1c 7%. During the 72-h Holter monitoring, basic rhythm was sinus and atrial fibrillation (AF) was not observed. Preoperative cranial magnetic resonance imaging (MRI) and carotid computed tomography (CT) angiography was reported as chronic infarction in the left Perisylvian region, the extra and intracranial arteries were open, and no calcification images were seen in the traced segments of the aortic wall (Figure 2).

On neurological examination, he had right-sided frieze paresis and mild dysarthria, and a modified Rankin score of 3. The patient was taking acetylsalicylic acid 100 mg/day, clopidogrel 75 mg/day, valsartan hydrochlorothiazide 160/12.5 mg/day, bisoprolol 5 mg/day, atorvastatin 40 mg/day, insulin aspart 10 units in the morning and 16 units in the evening, insulin glargine 24 units, and empagliflozin 10 mg/day.

The patient underwent of-pump CABGO surgery between LIMA - LAD and aorta - RCA (with saphenous vein). Endarterectomy was performed on both distal

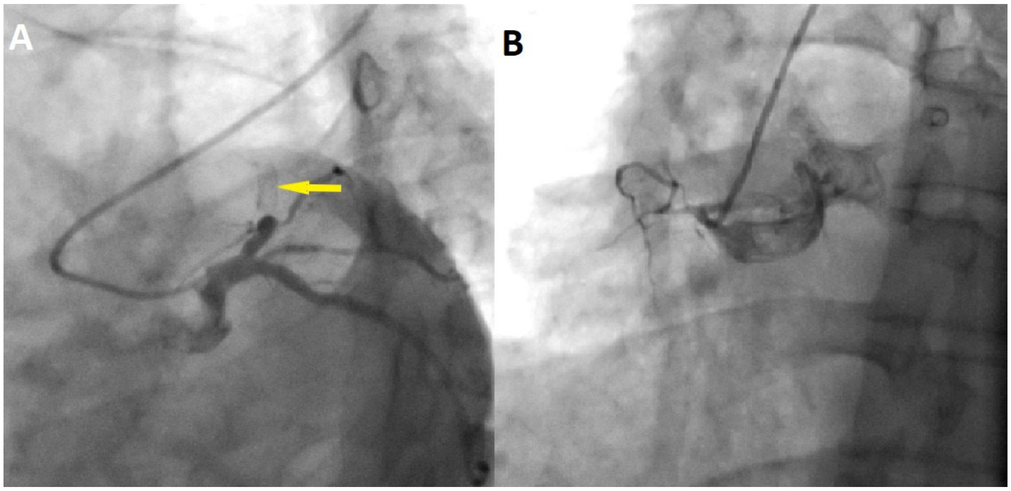

Figure 1. Coronary angiography image (occluded LAD stent)
LAD: Left anterior descending

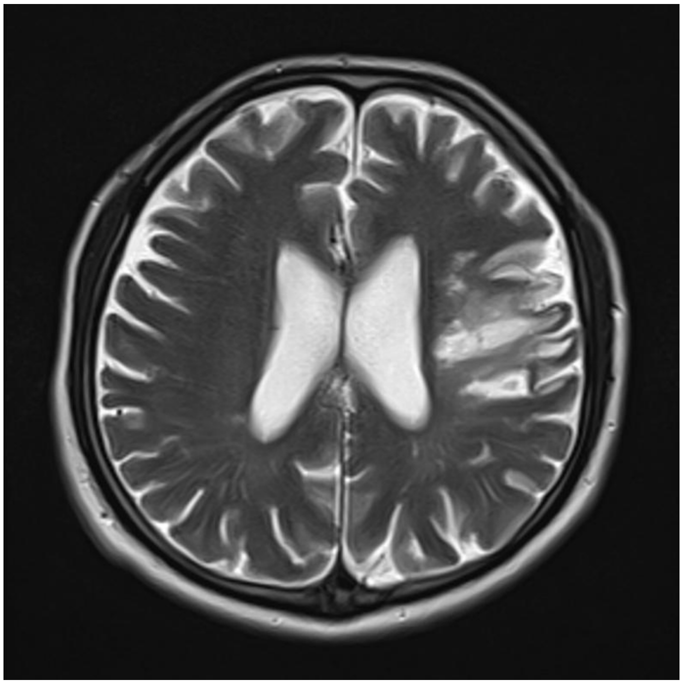

Figure 2. Preoperative cranial MRI image
MRI: Magnetic resonance imaging

anastomosis sites. At the end of the surgery, 0.08 micrograms/kg/min noradrenaline infusion was available as an inotropic support. The patient was extubated on postoperative day 0, the inotropic support was terminated by reducing on the postoperative 1st day, and his hemodynamics remained stable on the 2nd and 3rd postoperative days. On the 4th postoperative day, endotracheal intubation was performed upon detecting confusion, respiration superficialization, and hypoxia when the patient was in the sitting position. During the postoperative period, the patient was monitored and no blood pressure or rhythm problems that could impair hemodynamics were observed. In the brain diffusion MRI taken after the neurology consultation, a wide diffusion restriction at the vertex level in the right middle cerebral artery area was detected (Figure 3). The patient died on the 6th postoperative day of to multiorgan failure.

Discussion

According to the Trial of Org 10172 in Acute Stroke Treatment classification, ischemic stroke can be divided

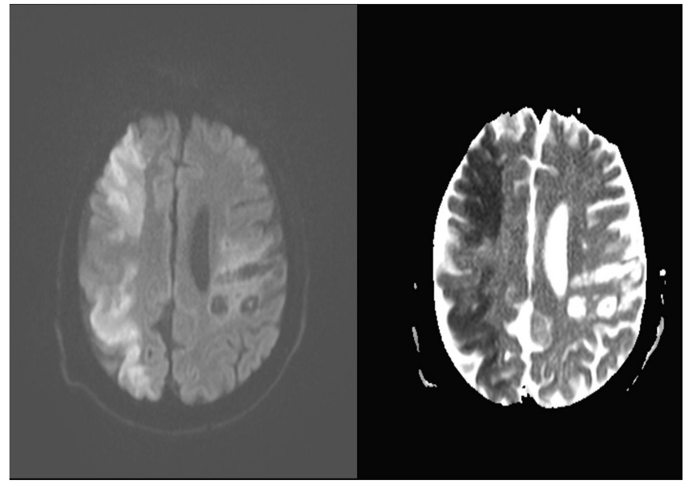

Figure 3. Postoperative cranial MRI image
MRI: Magnetic resonance imaging

into five subtypes: large-artery atherosclerosis, small-artery disease, cardioembolism, stroke of other determined etiologies, and stroke of undetermined etiology. The ischemic stroke of undetermined etiology, often referred to as cryptogenic stroke, accounts for 20-30% of all ischemic strokes. Cryptogenic stroke is a heterogeneous classification that consists of (1) true cryptogenic stroke with sufficient survey of etiology, (2) stroke within complete investigation, and (3) stroke with multiple causes[3,4]. The heterogeneous nature of cryptogenic stroke always has prevented the determination of the clinical features and optimal treatment of this type of stroke. Strategy determination studies have been conducted to determine the characteristics of this problematic clinical condition and secondary preventive treatments. In addition, most cryptogenic strokes show the clinical and radiographic appearance of embolism-like stroke from unknown sources. In 2014, Hart et al.[5] proposed a new clinical entity, which they defined as ESUS, to determine this problematic clinical situation. Therefore, the ESUS definition was designed to refine the cryptogenic stroke category by excluding patients with incomplete evaluation or multiple causes that could lead to stroke. A diagnostic definition of ESUS includes (1) non-lacunar infarction (small vessel occlusion, subcortical infarct ≤1.5 cm on CT or ≤2.0 cm on MRI), (2) no 50% large artery atherosclerotic stenosis supplying the ischemic area, (3) no major-risk cardioembolic sources permanent or paroxysmal AF, sustained atrial flutter, intracardiac thrombus, prosthetic cardiac valve, atrial myxoma or other cardiac tumors, mitral stenosis, myocardial infarction within the past 4 weeks, left ventricular (LV) ejection fraction <30%, valvular vegetation's or infective endocarditis, and (4) no other specific causes of stroke (such as vasculitis, dissection, migraine/vasospasm, drug misuse, etc.)[5].

Initially, the definition of ESUS was based on the hypothesis that AF would be the main cause of stroke in this subpopulation of cryptogenic stroke. Studies have shown that the results of in-depth examinations performed to establish a diagnosis of ESUS also revealed etiologies that were previously thought not to be related to ESUS. Cardiac abnormalities such as atrial cardiomyopathy, cardiac thrombus, patent foramen ovale, coagulation disorders, and underlying malignancies were cited among these. Currently, the relevance and causal effect of these etiologies for ESUS is unclear. Interestingly, recent studies suggest multiple or overlapping etiological causes for this stroke subtype[6].

Our case, who was evaluated by the neurology clinic before the operation in relation to a previous stroke, was evaluated as stroke associated with the ESUS subtype considering the etiological screening, clinical status, and radiological appearance. Stroke detected within the first 7 days after CABG is considered early postoperative stroke. Early postoperative strokes, although predicted to be primarily associated with arrhythmias and hemodynamic imbalances, are associated with embolic materials resulting from perioperative aortic manipulation, postoperative low cardiac output syndrome, and postoperative surgical bleeding[7].

In this study, the absence of any hemodynamic distress or any condition that could lead to hemodynamic distress for four days after surgery, the complete end of the need for inotropes in the early postoperative period, and the absence of any calcification image in the aortic wall in preoperative vascular imaging led us to the conclusion that the newly developed ischemic stroke was not associated with the surgical procedure.

In recent studies, it has been established that one-third of ESUS patients aged >45 years have coronary artery disease. In addition, LV wall motion abnormalities and LV diastolic dysfunctions have been associated with ESUS in patients with ESUS[8]. Also, DM and HT are independently associated with impaired LV function, and their coexistence creates a negative synergistic effect on LV mechanics[9].

The first stroke in our present case was evaluated in the context of ESUS, and the deterioration associated with ventricular dynamics was clearly detected in preoperative laboratory evaluations. All these data suggest that AIS, which develops postoperatively and resembles embolism-like stroke clinically and radiologically, is far from the causes of stroke that may arise due to perioperative and postoperative reasons. The fact that the patient experienced a new AIS episode after a peri- and postoperative period without any problems revealed our opinion that the processes related to ventricular dynamics would be a new area that should be discussed in the context of the ESUS subtype when the above literature information and the dynamics of the case were re-evaluated.

In the context of the case, the detection of coronary disease with the previous stroke followed by stent placement and subsequent surgical process suggest that ventricular dynamics in both the previous and postoperative periods may negatively contribute to all these processes.

Based on meta-analyses, the frequency of ESUS is estimated to be 17% (9 to 25%) of ischemic strokes. While most ESUS patients (86%) are treated with antiplatelet therapy during monitoring, the average annual stroke recurrence rate is 4.5% (2.3 to 6.8%)[5,10]. Although the long-term mortality risk is lower than cardioembolic strokes for ESUS patients despite similar composite cardiovascular endpoints and recurrence rates, it is associated with a higher risk of stroke recurrence than the probable recurrence risk for other non-cardioembolic strokes[11]. Some clinical features such as previous ischemic stroke or transient ischemic attack, advanced age, current tobacco use, multiple acute infarctions in neuroimaging, and diabetes are independent predictors of recurrent ischemic stroke in ESUS patients[12]. All these data reveal the importance of recognizing and evaluating the ESUS subtype. Consequently, knowing the etiology of stroke in patients with a preoperative history of stroke may shed light on the prediction and/or prevention of a new stroke that may develop postoperatively. There are no data revealing the relationship between stroke that develops after cardiac surgery, especially the history of preoperative stroke in the ESUS subtype and pre-operative stroke subtypes.

In conclusion, preoperative ESUS definition and treatment planning for neurologists and postoperative embolism-like stroke patterns and determination of goal and treatment toward the cause in terms of ESUS for cardiac surgeons are emerging as a new area of discussion. All in all, the necessity of cardiovascular and neurological physicians to work together in this field and to solve this mystery together is revealed once again.

Ethics

Informed Consent: Written consent of the patient was obtained.

Peer-review: Externally peer-reviewed.

Authorship Contributions

Surgical and Medical Practices: Işık M, Kozak HH, Yıldırım S, Tanyeli Ö, Concept: Işık M, Tanyeli Ö, Design: Işık M, Kozak HH, Yıldırım S, Data Collection and/or Processing: Işık M, Kozak HH, Analysis and/or Interpretation: Işık M, Kozak HH, Yıldırım S, Tanyeli Ö, Literature Search: Işık M, Kozak HH, Writing: Işık M, Kozak HH.

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