

ACUTE STROKE IN THE CARDIAC SURGERY PATIENT

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Problem statement:

Patients undergoing cardiac surgeries are exposed to a risk of cerebral injuries due to shared comorbidities. Neurological injuries are the second most common etiology for morbidity next only to heart failure.(1) The incidence of perioperative strokes varies in different types of surgeries. In this talk, subtype of strokes associated with frequent cardiac surgeries such as CABG, Carotid endarterectomy (CEA), aortic valve surgeries and extracorporeal membrane oxygenation (ECMO) will be discussed.

Ischemic stroke:

Incidence: Ischemic stroke is the most common of stroke subtypes seen across various cardiac surgeries and cause a 6 fold increase in morbidity and mortality.(2) In CABG, the most common procedure performed, the incidence of clinically significant strokes varies from 1.5%(3) to 5.2%(4) in prospective studies. Over the years, there has been a reduction in the rates and averages 1.6% (95% CI: 1.4%-1.7%) in the largest reported study.(5) In addition, multiple studies have demonstrated that the rates of ischemic strokes on and off by-pass pump are not different.(1) In valve replacement procedures, the risk of stroke is higher, with incidence 3-4% after mitral or aortic valve replacement. (6) The risk of strokes associated with CEA or carotid artery stenting (CAS) according to the CREST study is 1.6% and 4.1% respectively within 30 days. However, major strokes, defined as NIHSS > 9 occur in 0.3% and 0.9% in CEA and CAS patients.(7) Strokes in ECMO patients have been reported variably and is influenced by the etiology for the use of ECMO, age, arterial oxygenation (8) and in the largest case series: was noted to be 3.6%. (9) Combination of CABG with valve or other surgeries have an increased incidence of 7.9% and 7.2% respectively. (10) *Timing of stroke:* About 40% of all strokes are suspected to occur intra-operatively and 42% are noticed on the first post-operative day while 20% are noted on the second post-operative day. (11) Depending on the nature of the reported study, up to 80% of all strokes after various cardiac surgeries are diagnosed within the first 2 days of surgery. (10) Factors such as the duration of surgical procedure, depth, duration and the type of anesthesia, intra procedural hypoxia/ hypotension are critical determinants of the risk factors of stroke and in turn determine the detection of the symptoms.

Preventive strategies: All preoperative patients undergoing cardiac surgery should receive Aspirin and Statins. Pre-operative beta blocker use can reduce the incidence of atrial fibrillation. Avoiding intra-operative hypotension and hypoxia is beneficial. Limitations in management: Surgical cardiac procedures and the presence of myocardial infarction exclude the patients from thrombolysis unless there has been only PCI performed. Endovascular thrombectomy would be the preferred mode of treatment if the patient falls within the treatment window.(12) Careful selection of patients for endovascular therapy is warranted due to various antiplatelet agents and anticoagulants used in the perioperative phase. Limited data is available for the use of perfusion studies to aid patient selection. Maintenance of adequate perfusion with MAP, euglycemia, eunatremia, euthermia are of utmost importance.

Outcomes: Mortality of stroke patients following aortic valve replacement was 5%,(13) while in patients post CABG, the stroke patients had a higher mortality of 22%. (14) Patients with stroke undergoing CEA or CAS the estimated mortality rate at 4 years was 11.6% in the stroke-free group and 21.2% in the stroke group. In patients receiving ECMO, the mortality is very variable from 40%-95%. (9)

Hemorrhagic Stroke:

Incidence: The information for the overall incidence of hemorrhagic stroke following cardiac surgeries is not as clearly available but is estimated to be around <0.1% in CABG patients and 0.3% in the patients undergoing endarterectomy. ECMO patients are reported to have an increased risk of up to 1.8%, while the aortic valve replacements were associated with 1% incidence of ICH. However, the patients undergoing percutaneous coronary interventions have in increased rates of 8-0.46% of all peri-procedural strokes.(15, 16) This is likely related to the simultaneous use of both antiplatelet agents and anticoagulants.

Etiology: The suspected etiology of the hemorrhagic stroke in CABG patients is likely the hemorrhagic conversion of an ischemic stroke. There is a very high chance of hemorrhagic transformation post reperfusion of ischemic tissue due to blood-brain barrier compromise. In addition, large strokes, use to multiple antiplatelet agents and anticoagulants may precipitate or enhance hemorrhagic stroke. However, spontaneous ICH can also occur due to the use of anticoagulation during the cardiopulmonary bypass. In patients receiving ECMO, ICH is more likely related to anticoagulation with renal failure, low fibrinogen level and thrombocytopenia.(17)

Prevention: Prevention strategies for ischemic stroke and general avoidance of hypo/hypertension, hypoxia, and hyperthermia should be standard practice. In patients receiving anticoagulation, targeted therapy would be best. There appears no clear strategy that has been shown to reduce the incidence of hemorrhagic stroke following cardiac surgeries.

Treatment: Hemorrhagic stroke should be managed according the current AHA recommendations.(18) Standard measures to address airway, breathing, circulation and suspected elevated intracranial pressure as per the emergency neurological life support guidelines (ENLS).(19) Extreme hypertension should be controlled and stat neurosurgical consultation should be obtained. Reversal agents for anticoagulants should be considered cautiously. Activated factor VII containing products can be thrombogenic and need to be used with caution and in discussion with the cardiac intensivists, cardiologists and cardio-thoracic surgeons.

Outcomes: ICH carries very poor prognosis in cardiac surgery patients overall. Mortality rates are not very well studied in the literature related to CABG. However, with ECMO the rates are as high as 90%.(9)

Conclusions

Perioperative ischemic and hemorrhagic stroke following cardiac surgery carry significant morbidity and mortality. Preventive strategies, early recognition and institution of early treatment are important to impart better patient outcomes.

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