Utility of Brain Magnetic Resonance Imaging in the Surgical Management of Infective Endocarditis

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Background: Brain magnetic resonance imaging (MRI) is frequently obtained in patients with infective endocarditis, yet its utility in predicting outcomes for valve replacement surgery in patients is unknown. The objective of this study was to determine how brain MRI findings impact clinical management and outcomes. *Methods:* Demographic and clinical data from electronic medical records at Mayo Clinic were retrospectively reviewed for patients hospitalized with definite or possible infective endocarditis according to the modified Duke criteria between January 1, 2007 and December 31, 2014. There were 364 patients included in the study. *Results:* Cardiac valve replacement surgery was performed in 195 of 364 (53.6%) patients, and 95 (48.7%) of the surgical patients underwent preoperative MRI, which was associated with preoperative neurologic symptoms in 56 of 95 (58.9%) patients (odds ratio = 12.92; 95% confidence interval, 5.98-27.93; $P < .001$). Postoperative neurologic complications occurred in 24 of 195 (12.3%) patients, including new ischemic stroke in 4 of 195 (2.1%) and new intracerebral hemorrhage in 3 of 195 (1.5%). No patients with microhemorrhages developed postoperative hemorrhage. No significant differences existed in rates of postoperative complications between patients with and those without preoperative MRI. There were no substantial associations between preoperative MRI findings and postoperative neurologic complications, functional outcomes as described by the modified Rankin Scale score, or 6-month mortality. *Conclusions:* In patients undergoing valve replacement surgery, preoperative MRI findings were not associated with differences in postoperative

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outcomes, irrespective of finding or timing of valve replacement surgery. **Key Words:** Endocarditis—MRI—stroke—hemorrhage—surgery.
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Introduction

Infective endocarditis (IE) is associated with in-hospital mortality rates as high as 26%.[1] Neurologic complications of IE include stroke, mycotic aneurysm, brain abscess, intracerebral hemorrhage (ICH), and meningitis. Once found, a stroke may delay the timing of cardiac valve replacement surgery, potentially leading to a worse prognosis.[2,3] Guidelines by the Society of Thoracic Surgeons advise to wait at least 4 weeks following an embolic ischemic or hemorrhagic stroke to replace an infected valve, owing to the presumed increased risk of perioperative ICH in the setting of procedural anticoagulation and cardiopulmonary bypass.[4-6]

The optimal timing of valve repair in IE is one of the most complex decisions in cardiovascular surgery, and neurologists are often involved. Moreover, brain imaging, particularly magnetic resonance imaging (MRI), as it is commonly known to be more sensitive than computed tomography in detecting embolic phenomena, is frequently obtained in patients with IE to detect or predict complications, yet its ability to impact decisions that may alter clinical outcomes is unknown. The existing literature assessing the utility of brain MRI in endocarditis consists primarily of descriptive neuroimaging studies of small cohorts. These studies have not assessed the value of brain MRI in guiding clinical decisions and have not examined whether obtaining a preoperative MRI is associated with better postoperative outcomes.[5,7-21] In this study, we evaluated the impact of brain MRI findings on the clinical management and functional outcomes in patients with right- or left-sided IE. We hypothesized that there were no significant differences in clinical outcomes between patients who received MRI preoperatively and those who did not, thus questioning the value of obtaining an MRI and the consequent effects imaging findings may have on valve replacement.

Methods

Patient Population and Study Design

The Mayo Clinic Institutional Review Board approved this study. We identified 2123 patients with suspected or confirmed IE who received care at Mayo Clinic in Rochester, Minnesota, between January 1, 2007 and December 31, 2014. Patients excluded were those without definite or possible IE, lack of a neurologic assessment, lost to follow-up, or with incomplete data. This resulted in 364 patients with IE who were included in the study. Patients were divided into 2 groups: those who received preoperative MRI and those who did not receive preoperative MRI. Demographics and clinical characteristics including comorbidities, cardiac history consisting of risk factors for IE, medications, neurologic symptoms, and infectious organism were recorded. Patients were then divided into surgical and nonsurgical groups, based on whether they underwent valve replacement, and further assessed based on preoperative MRI findings. Outcomes of 6-month mortality, postoperative neurologic complications, and functional outcomes as described by the modified Rankin Scale[22] (mRS) were compared between patients with and those without preoperative MRI for patients who underwent surgery within 2 weeks of IE diagnosis, 4 weeks, and overall.

Neurologic Assessment

Patients underwent neurologic assessment and physical examination by neurologists during the hospital admission. Retrospectively, patients were categorized as either being asymptomatic, having symptoms focal to the brain or spine, having global symptoms involving the central nervous system, or as exhibiting both focal and global findings. Those who underwent valve replacement surgery were additionally assessed for postoperative neurologic complications consisting of new cerebral ischemia, new ICH, seizures, prolonged encephalopathy lasting more than 72 hours, new brain abscess, or death. Functional outcomes in terms of the mRS at hospital discharge and at last follow-up through December 31, 2014 were assigned based on nursing and physician medical records.

Neuroimaging

All neuroimaging studies for patients with IE were reviewed and interpreted by a neuroradiologist. Both radiology reports and source images were further assessed and catalogued in a REDCap database by a study author blinded to the clinical outcomes. Study date and imaging findings were recorded. MRI lesions were characterized as ischemic stroke, ICH, microhemorrhage, subarachnoid hemorrhage, or leptomeningitis. Ischemic lesions were defined as T2 hyperintense lesions with corresponding restricted diffusion on diffusion-weighted images. Microhemorrhages were defined as T2* hypointensities present on gradient or susceptibility-weighted sequencing with a diameter less than or equal to 10 mm. Subarachnoid hemorrhage was defined as linear hyperintensities on fluid-attenuated inversion recovery sequences or as T2* sequence hypointensities along the contours of cortical sulci. Leptomeningitis was defined

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