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Cerebral Septic Emboli

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**CEREBRAL
SEPTIC EMBOLI**



Muhammad
Affan, MD

Henry Ford
Hospital

OUTLINE

- Introduction
- Vascular complications in infective endocarditis
 - Ischemic stroke
 - Hemorrhage
 - Mycotic aneurysm
- Management
- Surgical indications
- Impact of neurological complication on patient management



CASE

- 27 yo F with history of IVDA presents with acute onset right sided weakness , numbness and facial droop.
- She is febrile and tachycardic
- Blood works showed elevated WBC.
- CT chest abdomen pelvis showed splenic infarcts and necrotic lesions in lungs bilaterally.



INTRODUCTION

- Infective endocarditis (IE) is an uncommon infectious disease with an annual incidence ranging from 3 to 7 per 100 000 person-years.
- IE is characterized by increased morbidity and mortality
- Third or fourth most common life-threatening infection syndrome, after sepsis, pneumonia, and intra-abdominal abscess.



Osler's Nodes

William Osler, 1909, on the eponymous Osler's nodes: "One of the most interesting features of [endocarditis] and one to which very little attention has been paid is the occurrence of ephemeral spots of a painful nodular erythema, chiefly in the skin of the hands and feet, the nodosités cutanées éphémères of the French... The commonest situation is near the tip of the finger, which may be slightly swollen."



DIAGNOSTIC CRITERIA

Definite IE

Pathological criteria

- Microorganisms demonstrated by culture or on histological examination of a vegetation, a vegetation that has embolized, or an intracardiac abscess specimen; or
- Pathological lesions; vegetation or intracardiac abscess confirmed by histological examination showing active endocarditis

Clinical criteria

- 2 major criteria; or
- 1 major criterion and 3 minor criteria; or
- 5 minor criteria

Possible IE

- 1 major criterion and 1 minor criterion; or
- 3 minor criteria

Rejected IE

- Firm alternate diagnosis; or
- Resolution of symptoms suggesting IE with antibiotic therapy for ≤ 4 days; or
- No pathological evidence of IE at surgery or autopsy, with antibiotic therapy for ≤ 4 days; or
- Does not meet criteria for possible IE, as above

Major criteria

1. Blood cultures positive for IE

- a. Typical microorganisms consistent with IE from 2 separate blood cultures:
 - *Viridans streptococci*, *Streptococcus gallolyticus* (*Streptococcus bovis*), *HACEK* group, *Staphylococcus aureus*; or
 - Community-acquired enterococci, in the absence of a primary focus; or
- b. Microorganisms consistent with IE from persistently positive blood cultures:
 - ≥ 2 positive blood cultures of blood samples drawn >12 h apart; or
 - All of 3 or a majority of ≥ 4 separate cultures of blood (with first and last samples drawn ≥ 1 h apart); or
- c. Single positive blood culture for *Coxiella burnetii* or phase I IgG antibody titre $>1:800$

2. Imaging positive for IE

- a. Echocardiogram positive for IE:
 - Vegetation;
 - Abscess, pseudoaneurysm, intracardiac fistula;
 - Valvular perforation or aneurysm;
 - New partial dehiscence of prosthetic valve.
- b. Abnormal activity around the site of prosthetic valve implantation detected by ^{18}F -FDG PET/CT (only if the prosthesis was implanted for >3 months) or radiolabelled leukocytes SPECT/CT.
- c. Definite paravalvular lesions by cardiac CT.

Minor criteria

1. Predisposition such as predisposing heart condition, or injection drug use.
2. Fever defined as temperature $>38^\circ\text{C}$.
3. Vascular phenomena (including those detected by imaging only): major arterial emboli, septic pulmonary infarcts, infectious (mycotic) aneurysm, intracranial haemorrhage, conjunctival haemorrhages, and Janeway's lesions.
4. Immunological phenomena: glomerulonephritis, Osler's nodes, Roth's spots, and rheumatoid factor.
5. Microbiological evidence: positive blood culture but does not meet a major criterion as noted above or serological evidence of active infection with organism consistent with IE.

NEUROLOGICAL COMPLICATIONS

- Symptomatic neurological complications occur in 15–30% of patients with IE, and new or recurrent events can also take place later in the course of the disease.
- Neurological manifestations occur before or at IE diagnosis. New or recurrent events can also take place later in the course of the disease.
- 7% can present with septic emboli as presenting sign of IE.

TABLE 2-1

Neurologic Complications of Endocarditis

▶ Infective Endocarditis

Cerebrovascular

Ischemic stroke

Hemorrhagic stroke

Mycotic aneurysm

CNS infections

Meningoencephalitis

Cerebritis

Abscess

Ventriculitis

Ependymitis

Secondary complications

Toxic-metabolic encephalopathy

Seizure

Headache



ISCHEMIC STROKE OR TIA

- Most common manifestation of IE
- Clinically in 20-40% patient with IE and additional 30% with asymptomatic lesions
Mechanism Likely embolism
- 65% of embolic events in IE involve the CNS, and 40-60% of CNS emboli lodge in the distribution of the middle cerebral artery.

Cerebrovascular complications in patients with left-sided infective endocarditis are common: a prospective study using magnetic resonance imaging and neurochemical brain damage markers, Brain MRI Findings in Neurologically Asymptomatic Patients with Infective Endocarditis

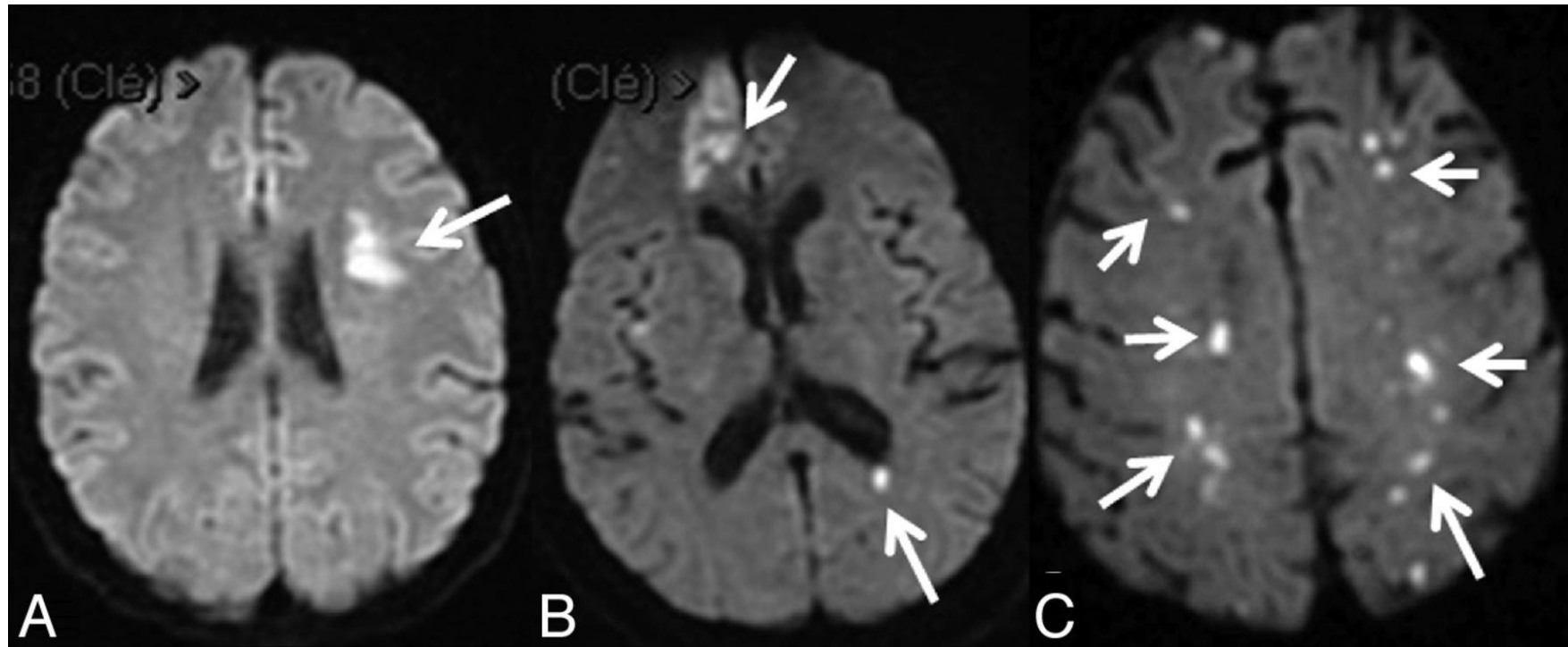
Neurologic manifestations of infective endocarditis: a 17-year experience in a teaching hospital in Finland. Arch Intern Med. 2000;160:2781-2787, Neurological Outcome of Septic Cardioembolic Stroke After Infec

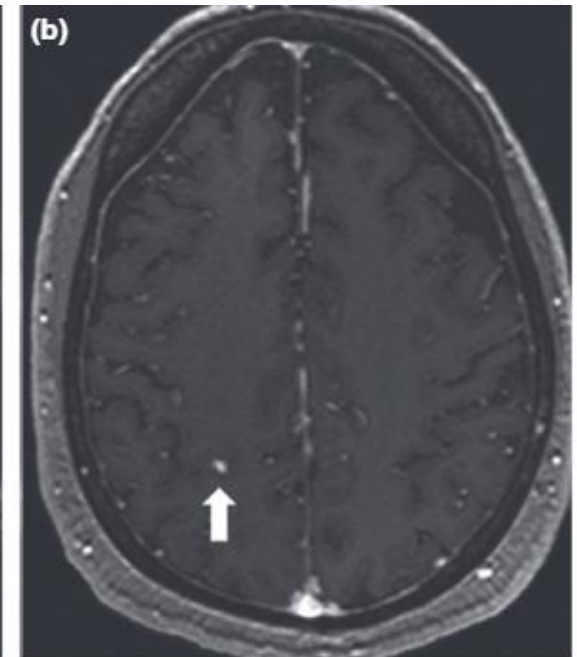
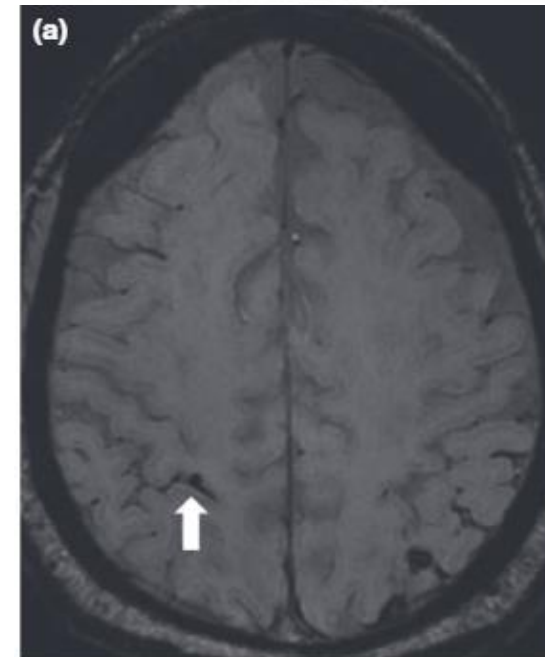
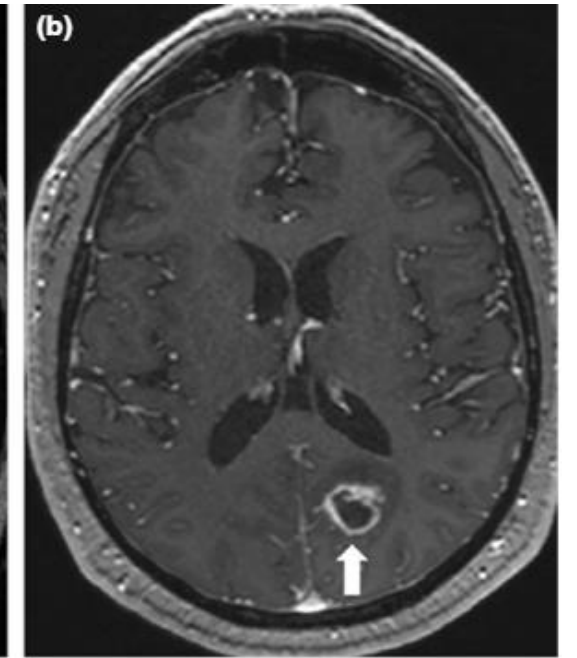
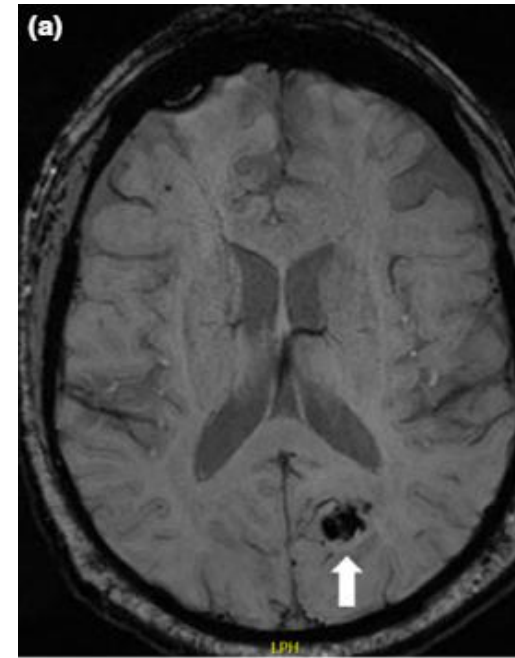
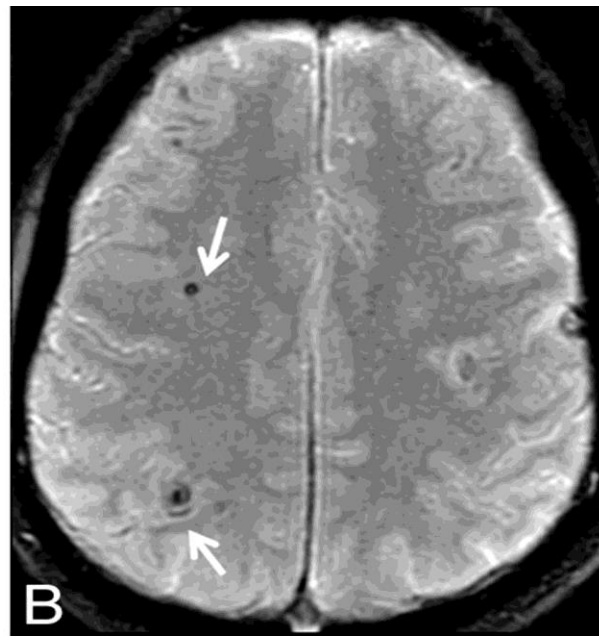
Clinical characteristics and thrombolytic outcomes of infective endocarditis-associated stroke.

Infective endocarditis due to Staphylococcus aureus: deleterious effect of anticoagulant therapy.



IMAGING CHARACTERISTICS



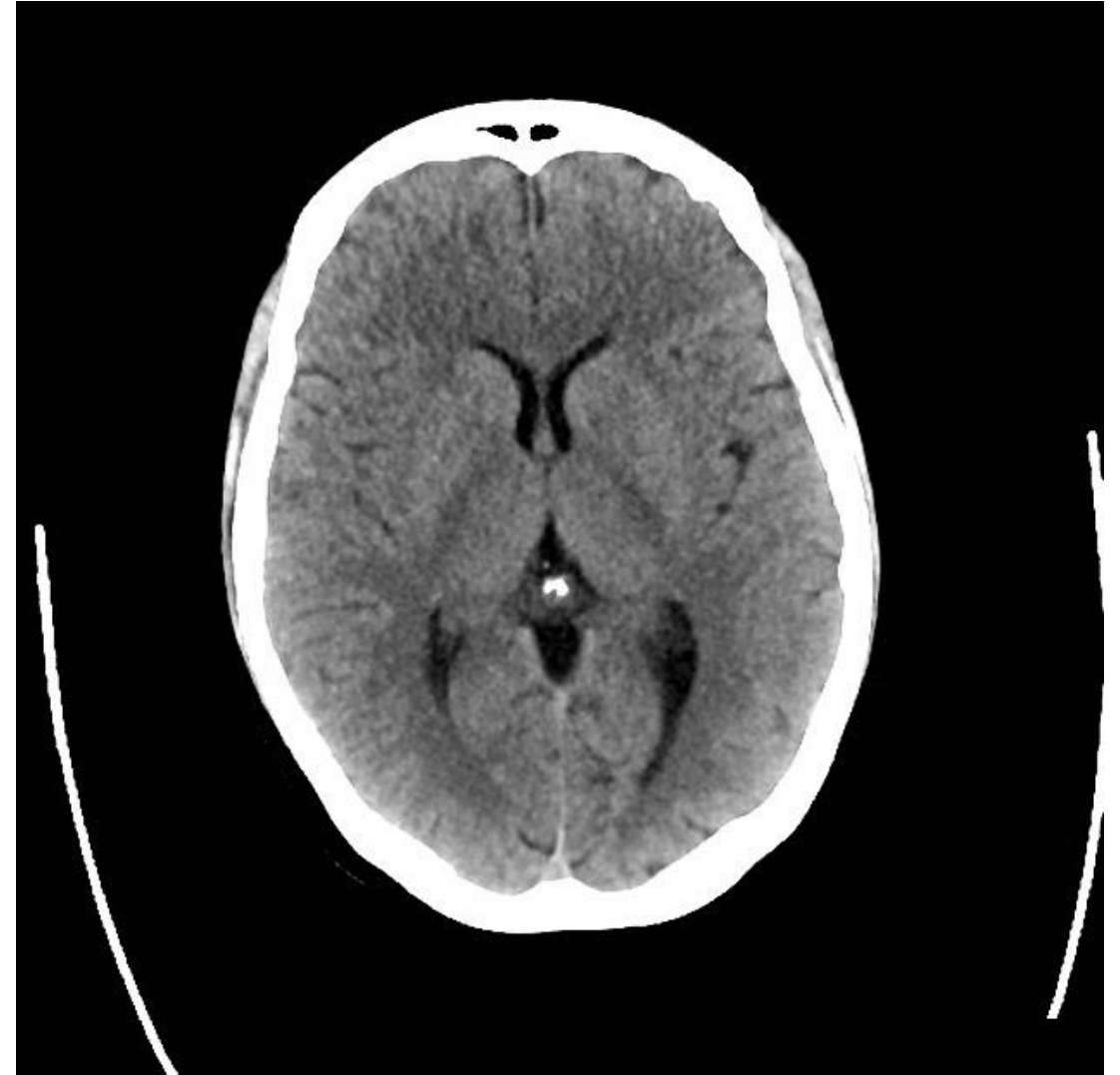


Microbleeds	Cases n (%)	Controls n (%)	OR 95% CI
<u>All study sample</u> (60 cases and 120 matched controls)			
>3	19 (31.7)	5 (4.2)	20.12 [5.20, 77.80]
1-3	15 (25.0)	13 (10.8)	6.12 [2.09, 17.94]
None	26 (43.3)	102 (85.0)	(ref.)

Cho SM et al. Cerebral microbleeds predict infectious intracranial aneurysm in infective endocarditis. Hess A Brain MRI findings in neurologically asymptomatic patients with infective endocarditis. *AJNR* Am J Neuroradiol. 2013 Aug;34(8):1579-84

STORY CONTINUES....

- Update in history: Patient was seen last time normal 2 hours ago.



THROMBOLYSIS IN IE

Table. Interventions and Outcomes of Acute Ischemic Stroke Patients Treated With Intravenous Thrombolysis With or Without Infective Endocarditis

	Patients With IE	Patients Without IE	P Value
Total	222	134 048	
Outcomes (%)	Infective endocarditis		
Seizure	For patients with AIS and symptoms consistent with infective endocarditis, treatment with IV alteplase should not be administered because of the increased risk of intracranial hemorrhage. † (COR III: Harm; LOE C-LD)§		
Favorable outcome	(Recommendation wording modified to match COR III stratifications.)		
Post-thrombolytic			

Patient #	Presenting Stroke Subtype			Initial NIHSS	Diagnosed IE at Stroke Presentation	Pathogen	Intervention	Follow-Up Imaging	Outcome (mRS)	
	Ischemia	ICH	SAH							
1 ^a	X			15	No	<i>S viridans</i>	IV-tPA	HT (ICH)	5	
2	X		X	4	Suspected	<i>S viridans</i>	None	Expected evolution	6	
3 ^a	X			16	Suspected	<i>E faecalis</i>	None	Expected evolution	4	
4	X			13	Yes	<i>P aeruginosa</i>	None	Expected evolution	6	
5 ^a	X			14	No	<i>Coag-neg Stap</i>	IA-tPA, Merci	HT (ICH), SDH	6	
6	X			1	Suspected	None identified	None	Not done	0	
								Not done	1	
								New ischemia, HT (ICH + IVH)	5	
								ICH, SAH	6	
								Merci	HT (ICH + IVH), SAH	6
								New ischemia	6	
								Expected evolution	6	
13 ^a	X		X	-	Yes	<i>Staphylococcus</i>	IA-tPA, angioplasty	Expected evolution	6	
14	X			19	No	<i>Enterococcus</i>	None	Expected evolution	4	
15			X	1	Yes	<i>S milleri</i>	None	SDH	1	
16			X	X	-	<i>MSSA</i>	None	Expected evolution	6	
17	X			14	Suspected	None identified	None	New ischemia, HT	6	
18	X			9	No	<i>MSSA</i>	None	Expected evolution	4	



Mechanical Thrombectomy for Acute Ischemic Stroke Secondary to Infective Endocarditis.

Ambrosioni J¹, Urra X², Hernández-Meneses M¹, Almela M³, Falces C⁴, Tellez A¹, Quintana E⁵, Fuster D⁶, Sandoval E⁵, Vidal B⁴, Tolosana JM⁴, Moreno A¹, Chamorro A², Miró JM¹; Hospital Clínic Infective Endocarditis Study Group.

Collaborators (33)

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- 6 Nuclear Medicine Service, Hospital Clínic-Institut d'Investigacions Biomèdiques August Pi i Sunyer (IDIBAPS), University of Barcelona, Spain.

Abstract

Intravenous thrombolysis is contraindicated in acute ischemic stroke secondary to infective endocarditis. We report our initial experience in 6 cases of proximal vessel occlusion treated with mechanical thrombectomy, which was safe (no bleeding) and effective (significant early neurological improvement) and might be useful in this clinical setting.

Case Rep Neurol. 2016 Oct 31;8(3):229-233. eCollection 2016 Sep-Dec.

Intra-Arterial Mechanical Thrombectomy: An Effective Treatment for Ischemic Stroke Caused by Endocarditis.

Sveinsson O¹, Herrman L², Holmin S².

Author information

- 1 Department of Neurology, Karolinska University Hospital, Stockholm, Sweden.
- 2 Department of Neuroradiology, Karolinska University Hospital, Stockholm, Sweden.

Abstract

Patients with stroke secondary to infectious endocarditis have a high in-hospital morbidity and mortality, with only one-third becoming functionally independent. Infective endocarditis is usually considered a relative contraindication to thrombolytic therapy. We describe 3 consecutive cases of acute middle cerebral artery occlusion due to infective endocarditis, who were all successfully treated with intra-arterial mechanical thrombectomy using the Solitaire device. From this limited experience, mechanical thrombectomy could be used as an effective acute treatment for ischemic stroke in patients with infective endocarditis. Mechanical thrombectomy is most likely a more effective and safer treatment than intravenous thrombolysis in this patient group.

CASE SERIES

Endovascular management of cerebral septic embolism: three recent cases and review of the literature

Eugene L Scharf,¹ Tia Chakraborty,² Alejandro Rabinstein,² Amrendra S Miranpuri³

ABSTRACT

Endovascular management of acute ischemic stroke secondary to septic emboli from bacterial endocarditis is case-specific and outside established guidelines. We report three new cases of an acute ischemic stroke secondary to septic embolus from two different centers. All cases reported here were large vessel occlusions of the middle cerebral artery in anticoagulated patients. In one case the embolus was noted to be firm and aspiration thrombectomy was attempted in lieu of stent retrieval. Thrombolysis in Cerebral Ischemia (TICI) 3 recanalization was achieved and the patient experienced a good outcome with resolution of deficits. In this case, pathologic analysis of the embolus was available. These additional three cases from two centers add to the small but growing literature for interventional management of acute ischemic stroke in bacterial endocarditis.

admission. Two weeks after hospital discharge the patient was found on the floor at home confused and altered. On presentation the patient was febrile and the white blood cell count was elevated to 20×10^3 cells/ μ L with neutrophil predominance. Axial CT of the brain revealed the presence of a subacute right inferior frontal infarct with mild hemorrhagic transformation but no cytotoxic edema or midline shift. The patient was admitted to hospital and treated empirically for sepsis. Transesophageal echocardiography suggested the presence of vegetation on both the mitral valve prosthesis and native aortic valve. The patient was continued on broad spectrum antibiotics and therapeutic anticoagulation with low molecular weight heparin.

Two weeks into the hospitalization the patient



THROMBECTOMY IN IE

Type of acute ischemic stroke therapy	IVT	EVT	Overall	<i>P</i> Value
Cohorts and procedural subtypes, n	Twelve cohorts	Sixteen cohorts: Thrombectomy: 12 Thrombolysis: 1 Combined: 3	Thirty-eight cohorts	
Total Participants, n	Nineteen IVT alone: 18 IVT+EVT: 1	Twenty-one Thrombectomy: 14 Thrombolysis: 2 Combined: 5	40	
Age, median (IQR)	61.5 (48-69)	48.5 (37.5-67)	56 (43-69)	0.26
Initial NIHSS, median (IQR)	13 (10-15)	14.5 (13-17)	14 (11-16)	0.22
Post-therapy NIHSS at 24 hours, median (IQR)	4.5 (1-19)	4 (2-10)	4 (1-14)	0.53
Dramatic Recovery at 24 hours	6/19 (32%)	11/19 (58%)	17/38 (45%)	0.19
Number not reporting, n	0	2	2	
Any post-therapy ICH	12/19 (63%)	3/17 (18%)	15/36 (42%)	0.008
Number not reporting, n	0	4	4	
Symptomatic ICH	8/19 (42%)	2/17 (12%)	10/36 (28%)	0.07
Good neurological outcome by 3 months	7/19 (37%)	13/21 (62%)	20/40 (50%)	0.20
In-hospital mortality rate	4 /19 (21%)	4/21 (19%)	8/40 (20%)	1.0

FURTHER MANAGEMENT



Prevent further neurological complications or deteriorations.



Decrease risk of embolization.



RISK OF EMBOLIZATION

- Systemic embolization in 22% to 50% of cases of IE. Most commonly brain and spleen.
- The highest incidence of embolic complications is seen with:
 - Mitral valve with particular micro-organisms (*S. aureus*, *S. bovis*, *Candida*)
 - Size and mobility of the vegetations :Vegetation >10 mm in length. Higher risk in patients with larger (>15 mm) and mobile vegetations.
 - The risk of new events (occurring after initiation of antibiotic therapy) is 6– 21%.



Recommendations

1. Infectious diseases consultation should be obtained to define an optimal empirical treatment regimen at the time of initiation of antimicrobial therapy (*Class I; Level of Evidence B*).
2. It is reasonable that the counting of days for the duration of antimicrobial therapy begin on the first day on which blood cultures are negative in cases in which blood cultures were initially positive (*Class IIa; Level of Evidence C*).
3. It is reasonable to obtain at least 2 sets of blood cultures every 24 to 48 hours until bloodstream infection has cleared (*Class IIa; Level of Evidence C*).
4. If operative tissue cultures are positive, then an entire antimicrobial course is reasonable after valve surgery (*Class IIa; Level of Evidence B*).
5. If operative tissue cultures are negative, it may be reasonable to count the number of days of antimicrobial therapy administered before surgery in the overall duration of therapy (*Class IIb; Level of Evidence C*).
6. It is reasonable to time the administration of antimicrobial therapy at the same time or temporally close together for regimens that include >1 antimicrobial agent (*Class IIa; Level of Evidence C*).

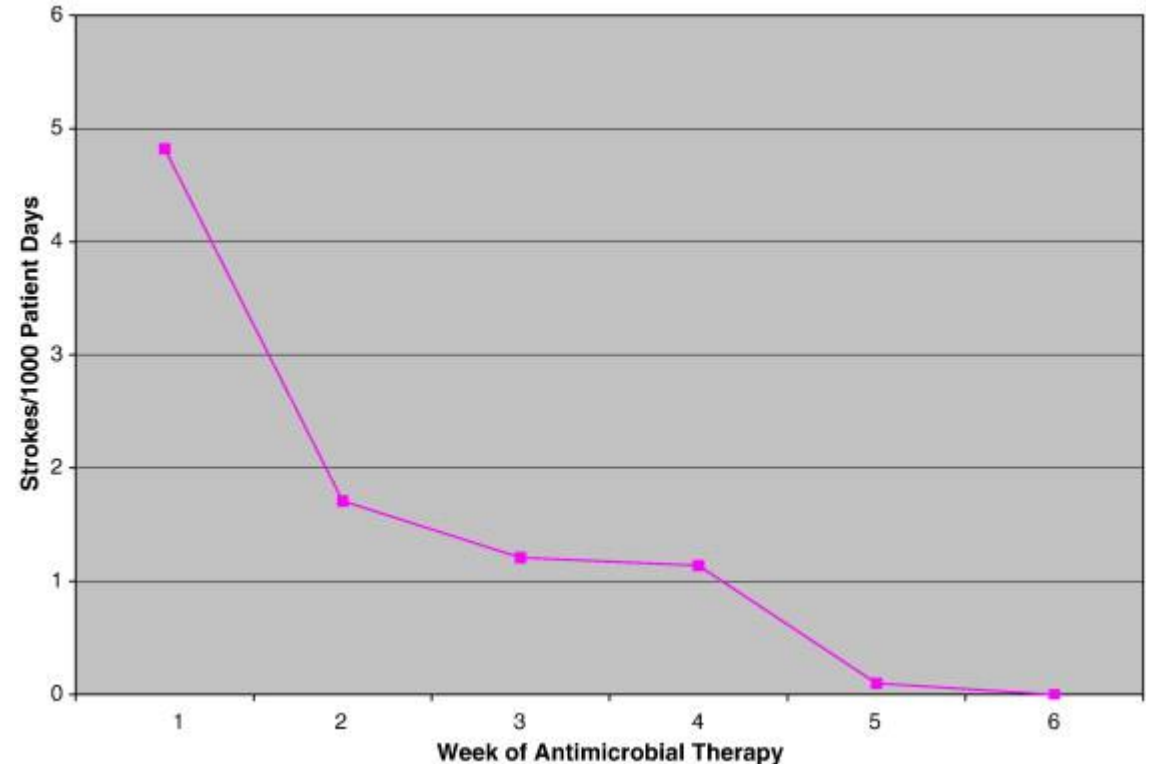
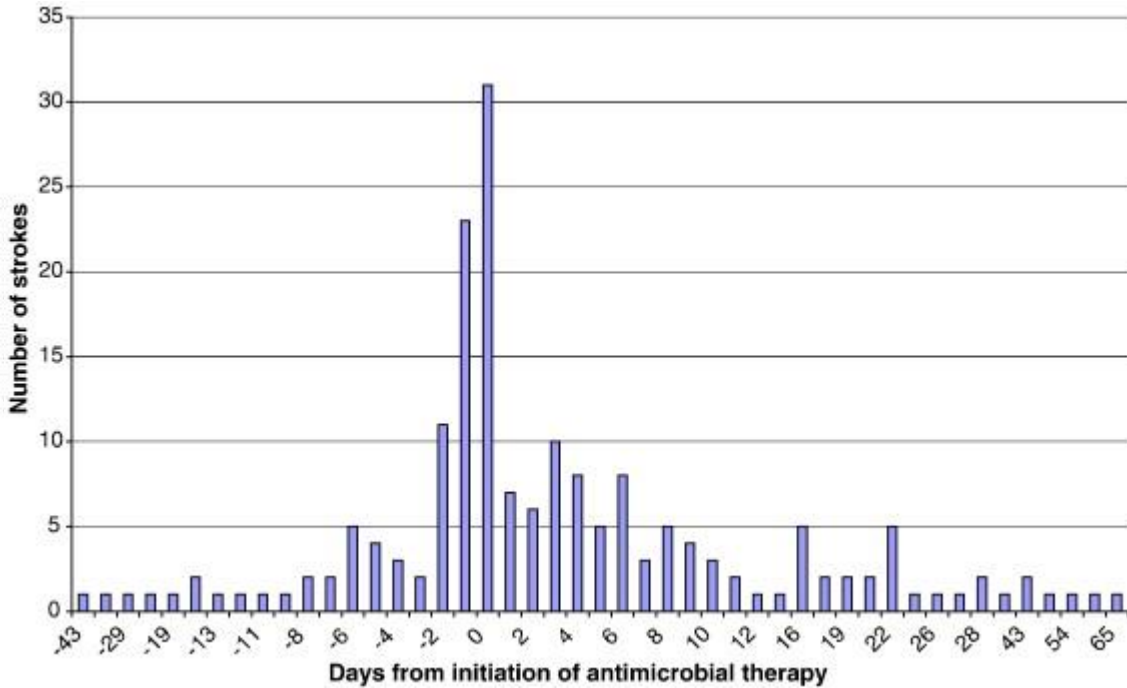
ANTIBIOTICS

- The primary goal of antibiotic treatment is to eradicate infection and sterilizing vegetation.
- Challenges include:
 - Focal infection with high bacterial density
 - Slow rate of bacterial growth
 - Low microorganism metabolic activity
 - Host immunity
 - Drugs pharmacokinetics and dynamics



ANTIBIOTICS AND STROKE

A study from the ICE group demonstrated that the incidence of stroke in patients receiving appropriate antimicrobial therapy was 4.8/1000 patient-days in the first week of therapy, falling by 65% to 1.7/1000 patient-days in the second week, and further thereafter.



Am Heart J. 2007 Dec;154(6):1086-94. Epub 2007 Sep 12.

The relationship between the initiation of antimicrobial therapy and the incidence of stroke in infective endocarditis: an analysis from the ICE Prospective Cohort Study (ICE-PCS).

Dickerman SA



Impact of prior antiplatelet therapy on risk of embolism in infective endocarditis.

Anavekar NS¹, Tleyjeh IM, Anavekar NS, Mirzoyev Z, Steckelberg JM, Haddad C, Khandaker MH, Wilson WR, Chandrasekaran K, Baddour LM.

ANTI-PLATELETS?

Clin Infect Dis. 2008 Jan 1;46(1):37-41. doi: 10.1086/524021.

Effect of long-term aspirin use on embolic events in infective endocarditis.

Chan KL¹, Tam J, Dumesnil JG, Cujec B, Sanfilippo AJ, Jue J, Turek M, Robinson T, Williams K.

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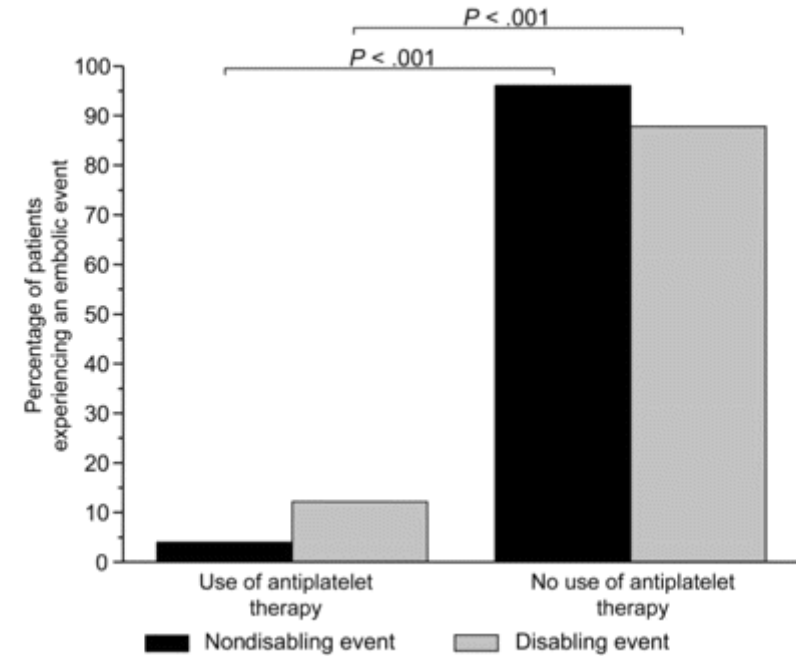
Abstract

BACKGROUND: In a recent clinical trial, aspirin therapy was initiated approximately 34 days after the onset of symptoms but did not reduce the risk of embolism in patients with endocarditis. However, it is possible that aspirin used early in the course of the disease may be beneficial. The purpose of the study is to assess the effect of long-term daily aspirin use on the risk of embolic events in patients with infective endocarditis.

METHODS: The clinical characteristics and outcomes of patients excluded from the Multi-Centre Aspirin Trial in Infective Endocarditis because of long-term aspirin use (n = 84) were compared with the data for patients randomized to the placebo arm (n = 55). The former patients took aspirin before and during the early stages of infective endocarditis, whereas the latter patients were not exposed to aspirin before and during the entire hospitalization. Logistic modeling was used to assess the effect of long-term aspirin use on embolism and bleeding.

RESULTS: There was a trend toward excess bleeding in long-term aspirin recipients, compared with placebo recipients (P = .065). Logistic modeling revealed that long-term aspirin use may be associated with excess bleeding (unadjusted odds ratio, 2.35 [P = .059]; adjusted odds ratio, 2.08 [P = .118]), but it had no impact on the risk of embolic events in either model.

CONCLUSIONS: In patients with endocarditis, long-term daily use of aspirin does not reduce the risk of embolic events but may be associated with a higher risk of bleeding. In the acute phase of endocarditis, aspirin should be used with caution.



Variable	OR (95% CI)	P
Embolic events		
Antiplatelet therapy (unadjusted)	0.35 (0.20–0.63)	<.001
Antiplatelet therapy (adjusted) ^a	0.36 (0.19–0.68)	.002
Death within first 6 months^b		
Antiplatelet therapy (adjusted) ^a	0.29 (0.10–0.81)	.018



A randomized trial compared oral aspirin 325 mg/d with placebo in 115 IE patients. No significant benefit was observed in aspirin-treated patients in terms of vegetation resolution and embolic events. Moreover, there was a trend toward more bleeding episodes in the aspirin-treated patients. **A randomized trial of aspirin on the risk of embolic events in patients with infective endocarditis.**

	Aspirin (n = 59)	Placebo (n = 55)	OR (95% CI)	P Value
Embolism or intracranial hemorrhage	20 (33.9)	14 (25.5)	1.50 (0.67–3.38)	0.413
Embolism	17 (28.8)	11 (20)	1.62 (0.68–3.86)	0.287
Major bleeding				
Intracranial	7 (11.9)	3 (5.5)	2.33 (0.57–9.52)	0.324
>20 g/l drop in hemoglobin or into confined space	9 (15)	5 (10.9)	1.76 (0.55–5.63)	0.400
Minor bleeding	8 (13.6)	2 (3.6)	4.16 (0.84–20.52)	0.096
Major or minor bleeding	17 (28.8)	8 (14.5)	1.92 (0.76–4.86)	0.075

Initiation of aspirin or other antiplatelet agents as adjunctive therapy in IE is not recommended (*Class III; Level of Evidence B*).

The continuation of long-term antiplatelet therapy at the time of development of IE with no bleeding complications may be considered (*Class IIb; Level of Evidence B*).



ANTICOAGULATION?

ORIGINAL INVESTIGATION

Infective Endocarditis Due to *Staphylococcus aureus*

Deleterious Effect of Anticoagulant Therapy

Pilar Tornos, MD; Benito Almirante, MD; Sonia Mirabet, MD; Gaieta Permanyer, MD; Albert Pahissa, MD; Jordi Soler-Soler, MD

Neurologic Complications, Mortality, and Causes of Death in Patients With Left-sided Infective Endocarditis (IE) Caused by *Staphylococcus aureus*

	No. (%) of Patients	
	Native Valve IE (n = 35)	Prosthetic Valve IE (n = 21)
Neurologic complications		
Ischemic stroke*	7 (20)	5 (24)
Cerebral hemorrhage	1 (3)	6 (29)
Central nervous system infection	4 (11)	1 (5)†
Mycotic aneurysm	0 (0)	1 (5)
Overall mortality	13 (37)	15 (71)‡
Causes of death§		
Central nervous system events	0 (0)	11 (52)
Postoperative	5 (14)	3 (14)
Sepsis and multiorgan failure	6 (17)	1 (5)
Ventricular fibrillation	1 (3)	0 (0)
Digestive hemorrhage	1 (3)	0 (0)

All patients with prosthetic valve IE due to *S aureus* with mechanical prostheses were undergoing oral anticoagulant therapy, while no patient with native valve IE due to *S aureus* was undergoing such treatment. Therefore, it seems clinically plausible that anticoagulant therapy played a deleterious effect on the neurologic complications

1. Discontinuation of all forms of anticoagulation in patients with mechanical valve IE who have experienced a CNS embolic event for at least 2 weeks is reasonable (Class IIa; Level of Evidence C).

sided *Staphylococcus aureus* IE.

Methods: This report is based on all consecutive cases of IE diagnosed at our hospital between 1975 to 1997. Clinical data, including the use of anticoagulant therapy at the time of diagnosis, were prospectively obtained, and antibiotic treatment and surgical indications were uniform throughout the study period. Computed tomographic scans of all clinical records were reviewed.

Results: Of 637 consecutive patients with IE, 56 had left-sided *S aureus* IE affecting native valves in 35 patients and prosthetic valves in 21 patients. Of the patients with prosthetic valve IE, 19 (90%) were taking oral antico-

agulant therapy in pa-

tients who have expe-

rienced a CNS embolic event for at least 2 weeks is

reasonable (Class IIa; Level of Evidence C).

ant therapy

se of death

thetic left-

agulant therapy at the time of diagnosis while no patient with native valve IE was receiving such treatment. There were no differences between native valve IE and prosthetic valve IE in age, sex, embolic episodes, and number of central nervous system complications. Mortality was higher in prosthetic valve IE than in native valve IE (71% vs 37%; $P = .02$). No patient with native valve IE died due to central nervous system complications, while 73% (11 of 15 patients) with prosthetic valve IE died due to central nervous system complications. The difference in the distribution of the type of death (stroke vs other) was significant ($P < .007$).

Conclusions: Our results suggest that in left-sided *S aureus* IE anticoagulant therapy is closely associated with death due to neurologic damage. According to our data, as soon as the clinical diagnosis of *S aureus* IE is indicated the use of anticoagulant therapy should be immediately stopped until the septic phase of the disease is overcome.

Arch Intern Med. 1999;159:473-475



CASE UPDATE

- While in hospital patient worsens and has new focal neurologic deficits.
- A day prior she was deemed candidate for valve replacement surgery.



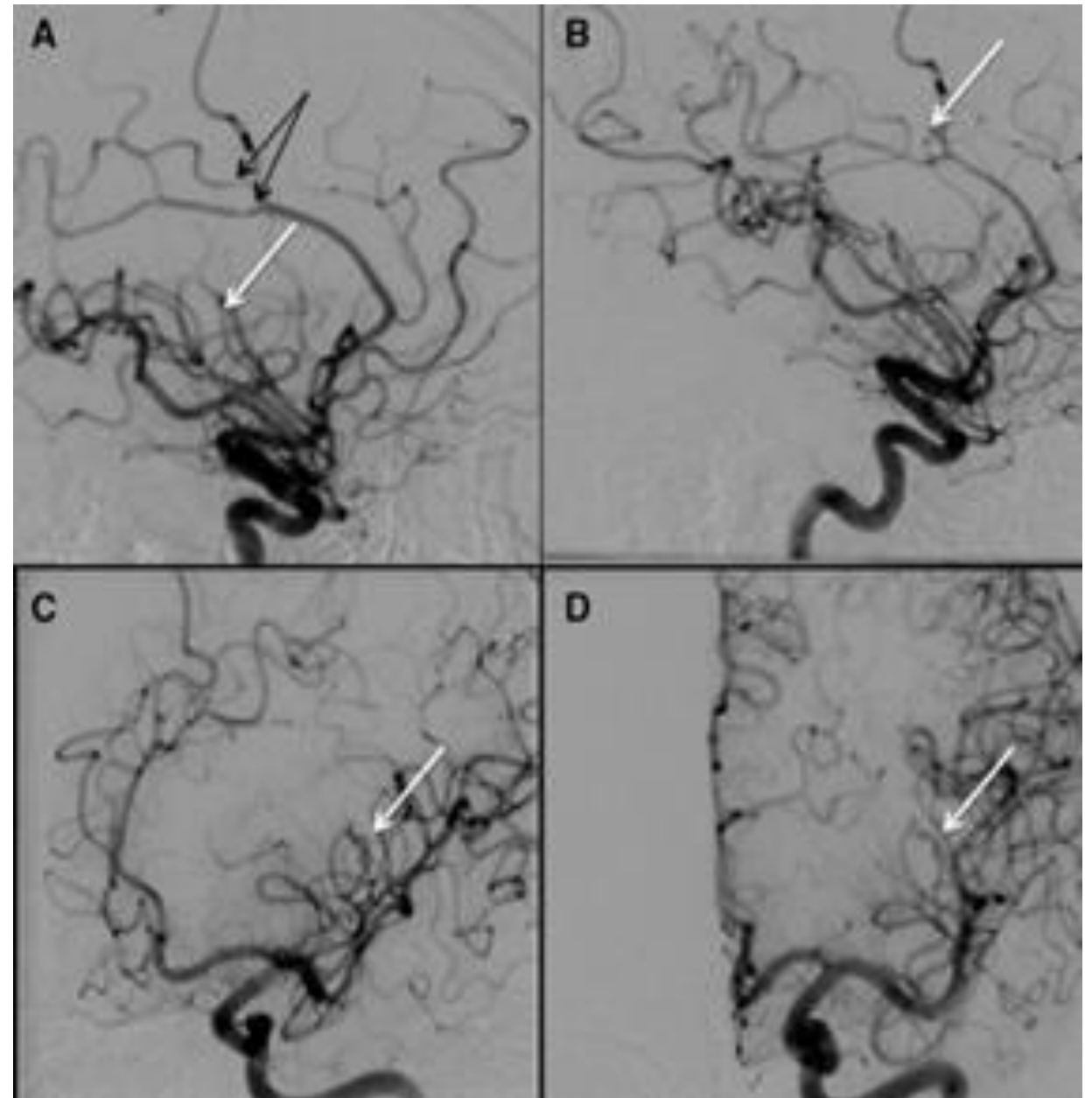
HEMORRHAGE

- Incidence vary from 4%-27%.
- ICH in IE related to bleeding into infarcts, rupture of a vessel wall affected by septic arteritis, or rupture of a mycotic aneurysm



MYCOTIC ANEURYSM

- Septic embolization to the arterial vasa vasorum or the intraluminal space
- Prevalence is 2% to 4%, amounting to 0.3% to 1.8% of all cerebrovascular complications and only 0.8% to 2.8% of those complicated by ICH.
- The overall mortality rate = 60%.
 - Unruptured ICMA, =30%
 - Ruptured ICMA, =80%.



*Hart et al, 1990; A dangerous dilemma: management of infectious intracranial aneurysms complicating endocarditis. Peters et al, 2006

**Bacterial intracranial aneurysm. J Neurosurg. 1978;48:369-382,



OUR EXPERIENCE

IE patients with cerebrovascular complications

Ischemia (N=49)

Hemorrhage
(N=22)

IV
Thrombolysis
N=1

Thrombectomy
N=1

Mortality 41%

Mortality 45%



INDICATIONS FOR SURGERY

Indication for surgery	Timing	Class of Recommendation	Level of Evidence
Valve dysfunction with heart failure	Early	I	B
Fungi or highly resistant organisms	Early	I	B
Heart block, annular or aortic abscess, or destructive penetrating lesions	Early	I	B
Persistent infection	Early	I	B
Recurrent emboli and persistent or enlarging vegetations despite appropriate antibiotic therapy	Early	IIa	B
Severe valve regurgitation and mobile vegetations >10 mm	Early	IIa	B
Mobile vegetations >10 mm, with anterior leaflet of the mitral valve	Early	IIb	C

Early : during initial hospitalization and before completion of a full course of antibiotics

2. When should the patient undergo operation?

Once an indication for surgery is established, the patient should be operated on within days	I	B	3-6
Earlier surgery (emergency or within 48 hours) is reasonable for patients with large mobile vegetations at imminent risk of embolism	Ila	B	3-6,46,62,133,137,138
In patients with stroke and neurologic deficits, timing is decided by weighing the need for cardiac surgery against the risk of expanding the stroke or provoking intracranial bleeding during the operation (see specific question about neurologic complications)	Ila	B	3-6,33,61-63,67,69,104,108,110,125,137,139-154

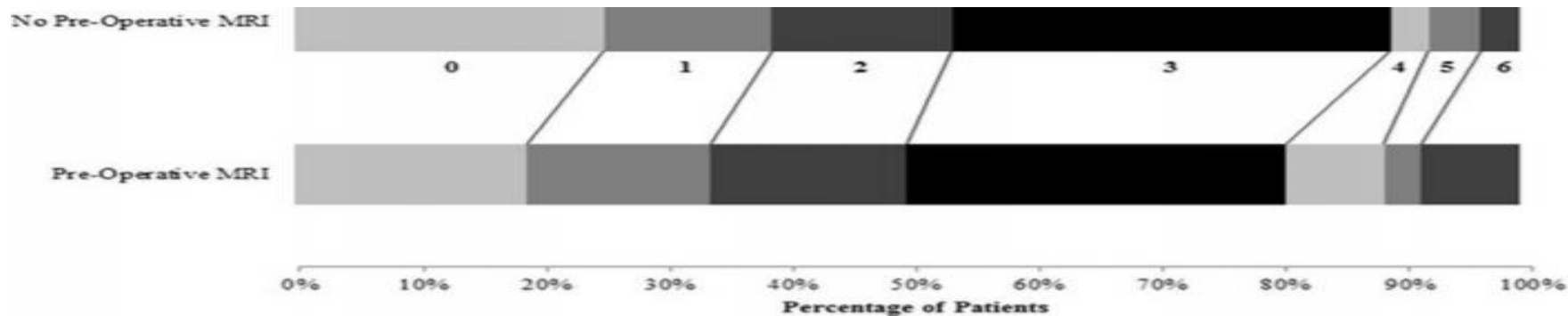


MRI ASSISTANCE IN SURGICAL DECISION

J Stroke Cerebrovasc Dis. 2017 Nov;26(11):2527-2535. doi: 10.1016/j.jstrokecerebrovasdis.2017.05.047. Epub 2017 Jun 30.

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

Chakraborty T¹, Scharf E², Rabinstein AA², DeSimone D³, El Rafei A³, Brinjikji W⁴, Baddour LM⁵, Wijidicks E⁶, Wilson W³, Steckelberg JM³, Fugate JE⁷.



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 outcomes, irrespective of finding or timing of valve replacement surgery.



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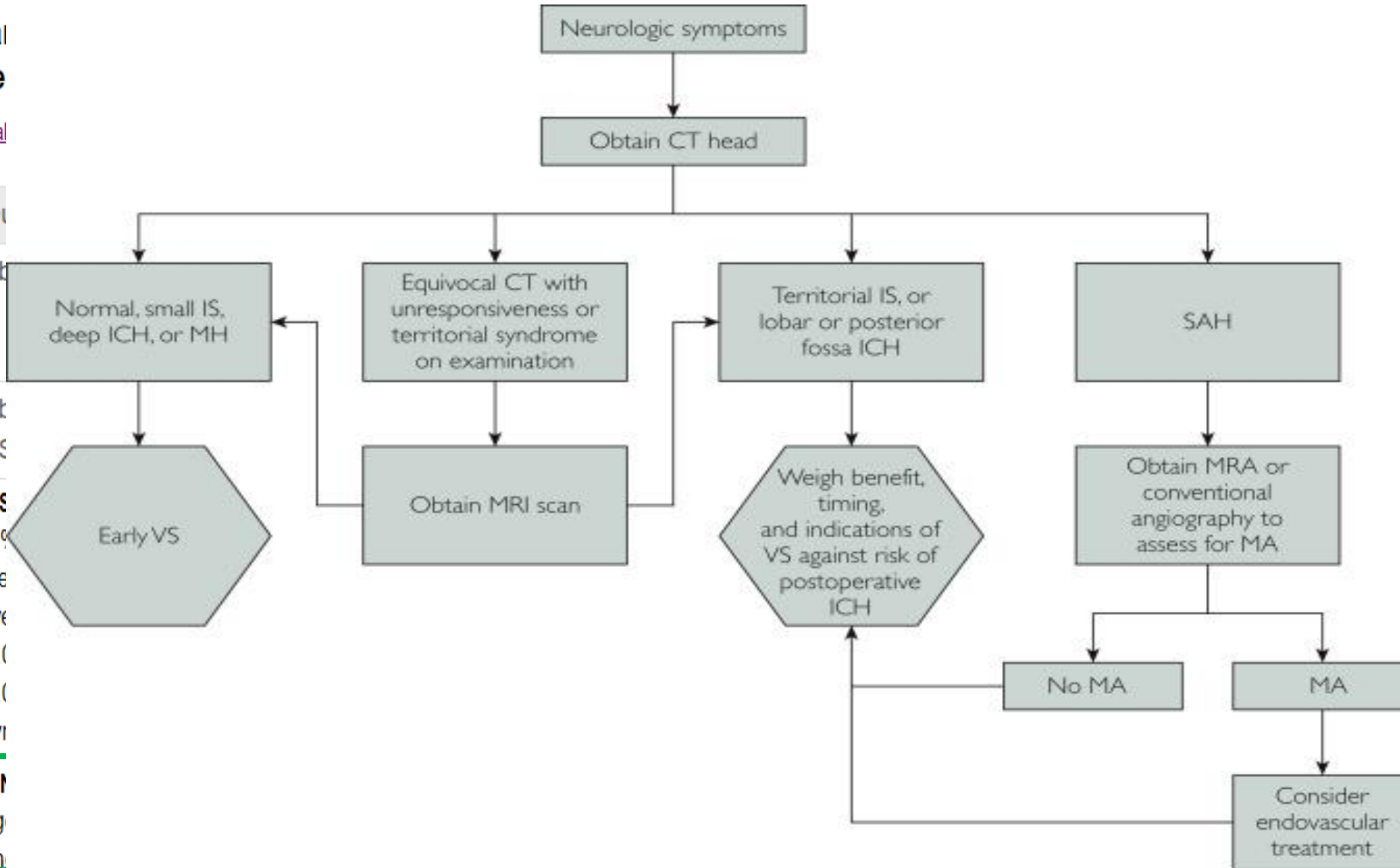
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TIMING OF SURGERY

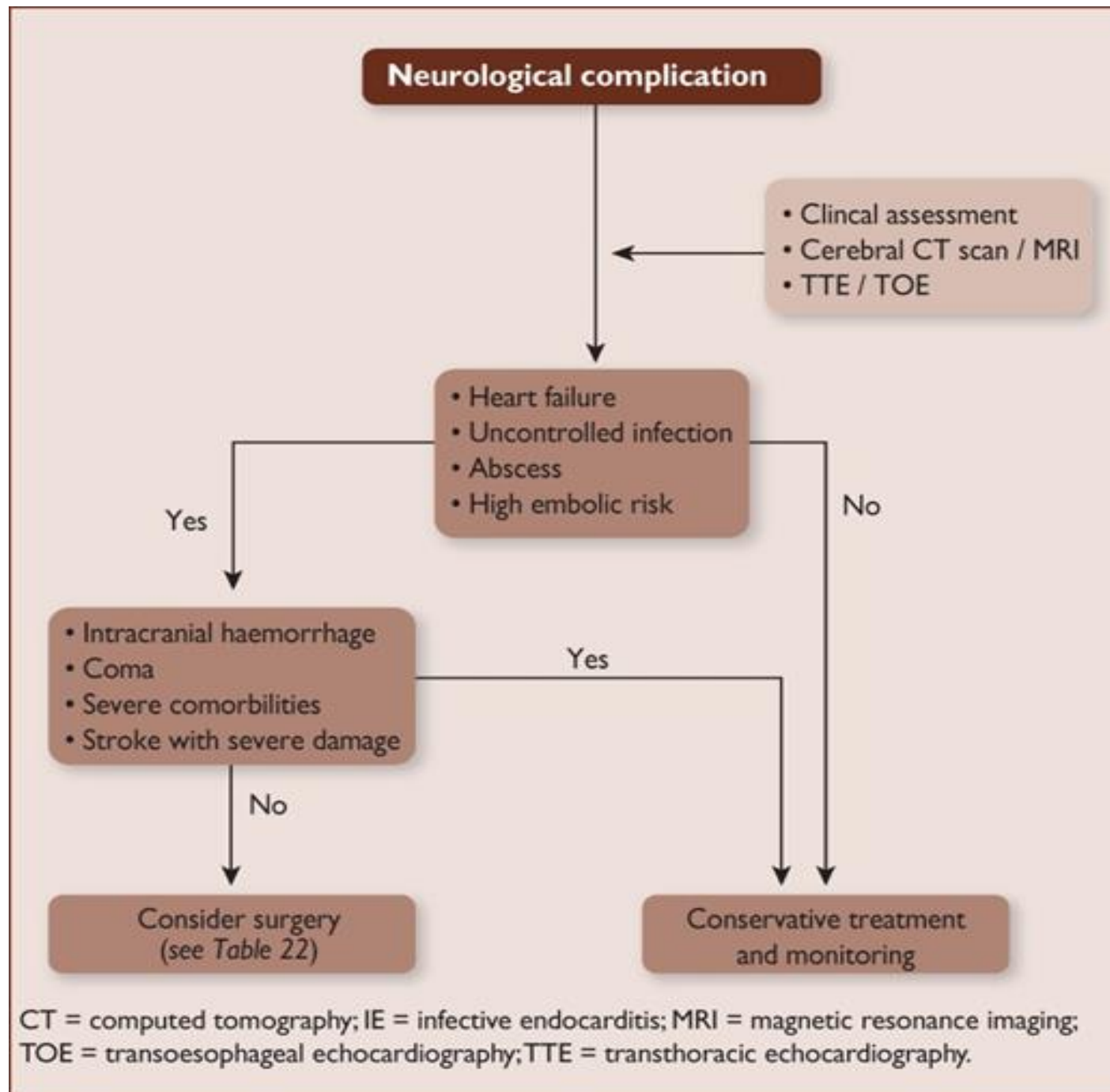
Recommendations

1. Valve surgery may be considered in IE patients with stroke or subclinical cerebral emboli and residual vegetation without delay if intracranial hemorrhage has been excluded by imaging studies and neurological damage is not severe (ie, coma) (Class IIb; Level of Evidence B).
2. In patients with major ischemic stroke or intracranial hemorrhage, it is reasonable to delay valve surgery for at least 4 weeks (Class IIa; Level of Evidence B).

Recommendations	Class ^a	Level ^b	Ref. ^c
After a silent embolism or transient ischaemic attack, cardiac surgery, if indicated, is recommended without delay	I	B	105, 263
Neurosurgery or endovascular therapy is recommended for very large, enlarging or ruptured intracranial infectious aneurysms	I	C	
Following intracranial haemorrhage, surgery should generally be postponed for ≥ 1 month	IIa	B	264–266
After a stroke, surgery indicated for HF, uncontrolled infection, abscess, or persistent high embolic risk should be considered without any delay as long as coma is absent and the presence of cerebral haemorrhage has been excluded by cranial CT or MRI	IIa	B	9,263
Intracranial infectious aneurysms should be looked for in patients with IE and neurological symptoms. CT or MR angiography should be considered for diagnosis. If non-invasive techniques are negative and the suspicion of intracranial aneurysm remains, conventional angiography should be considered	IIa	B	267, 268

Recommendations	COR	LOE	References
1. What is the effect of neurologic complications, embolic stroke, brain hemorrhage, and mycotic aneurysm on indication for and timing of surgery?			
If a cerebral mycotic aneurysm has been diagnosed, treatment and follow-up of the patient should be in close collaboration with neurologic and neurosurgery expertise	I	C	3,4,6,155
In patients with a recent intracranial hemorrhage, a delay of operation for 3 or more weeks is reasonable	IIa	B	3-6,138,141, 156-159
Earlier surgery is reasonable for patients with non-hemorrhagic strokes and a strong cardiac indication for urgent surgery	IIa	B	3-6,69,157, 160-162
Patients with large and multiple strokes and severe neurologic symptoms should be carefully evaluated by a neurologist before being offered surgery	I	B	3,4,6
For patients with IE and neurologic symptoms and significant intracranial hemorrhage, angiography should be considered to rule out mycotic aneurysm	IIa	B	3,4,6,155







CONCLUSION

- Infective endocarditis is life threatening infection with various neurological complications.
- Stroke is the most common neurologic complication.
- Presence of vascular complication significantly impacts outcomes and management options.
- A multidisciplinary team (Stroke Neurology, Infectious disease and CTS) based approach is essential for management of these complex patients.

