

2016 Annual Spring Scientific Conference of the KSC
April 15-16, 2016

Surgical Indications of Infective Endocarditis in Children

Cheul Lee, MD

Pediatric and Congenital Cardiac Surgery

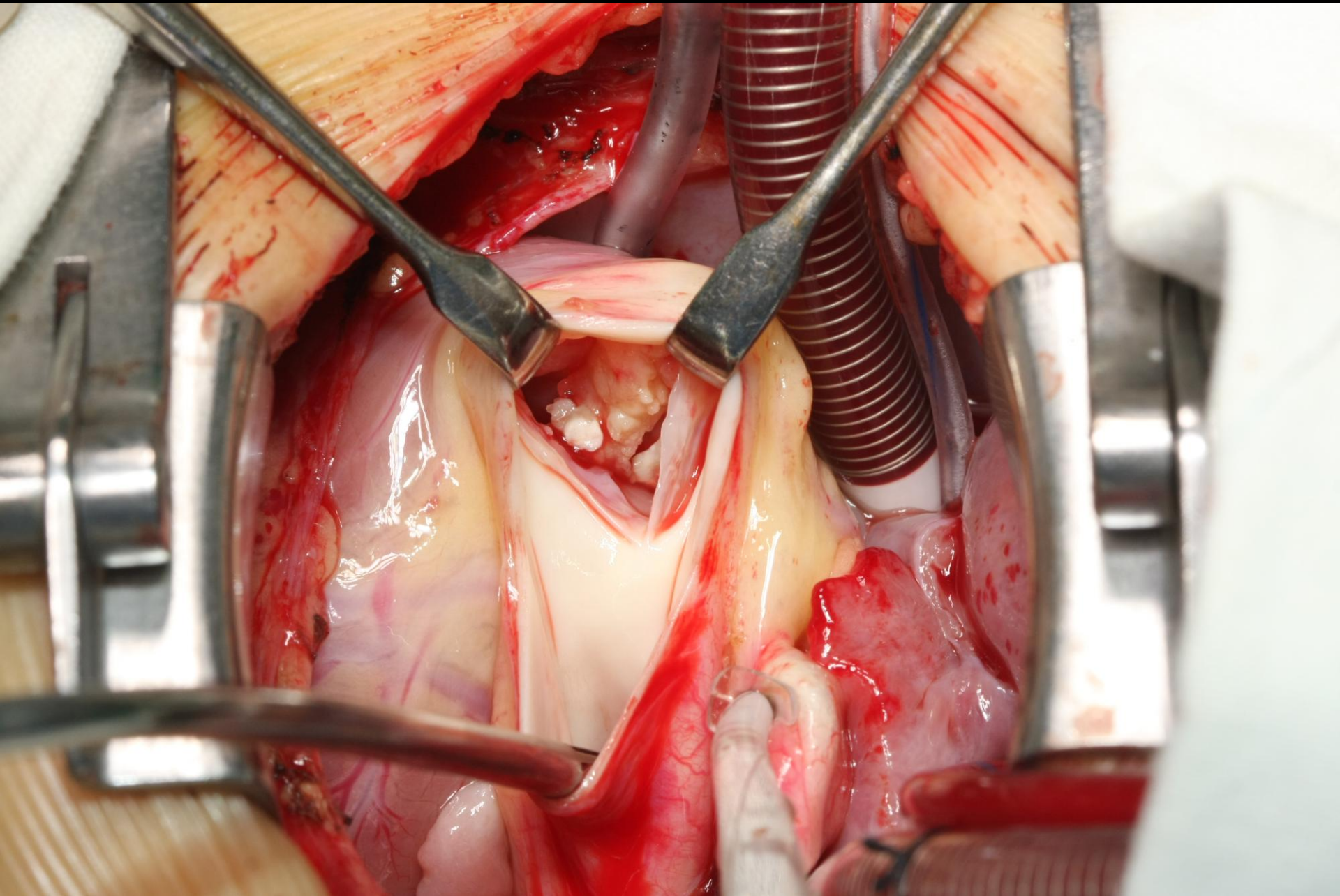
Seoul St. Mary's Hospital

College of Medicine, The Catholic University of Korea

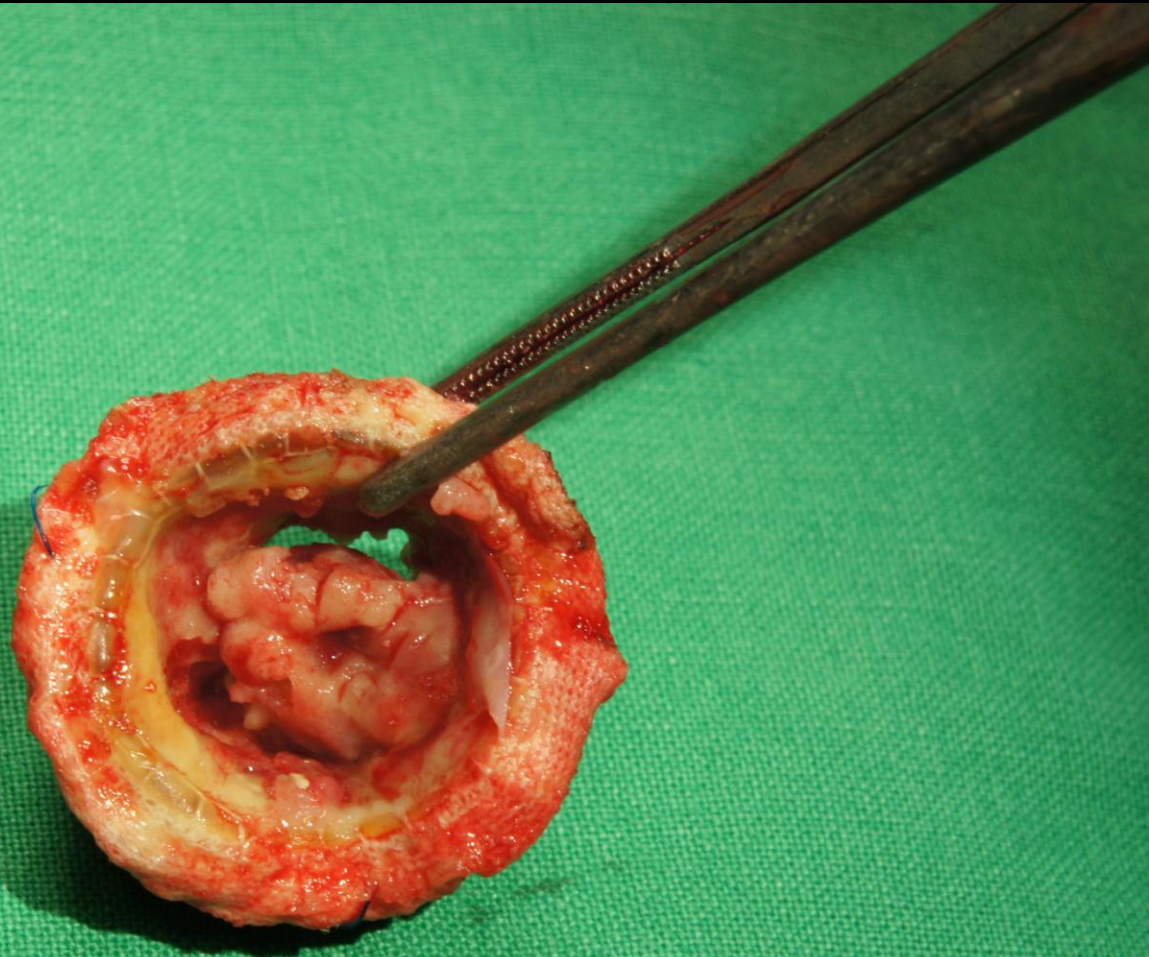
Increasing Role of Surgery in Infective Endocarditis

- The proportion of infective endocarditis patients undergoing surgery has increased over time to reach approximately 50%.

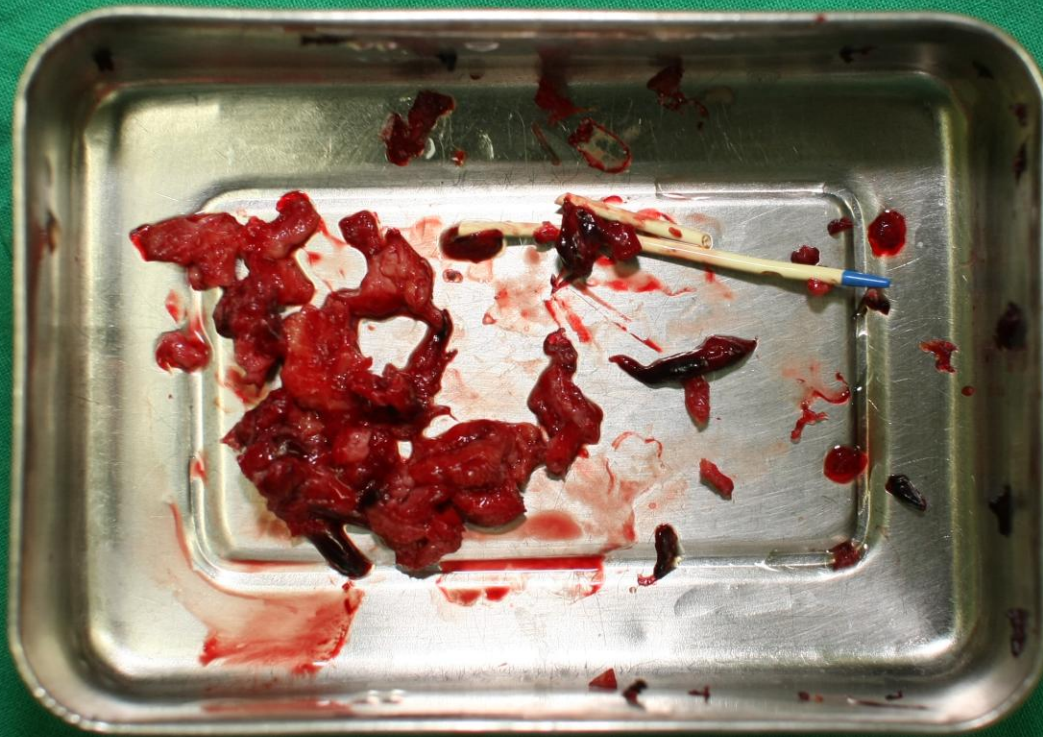
Native Valve Endocarditis



Prosthetic Valve Endocarditis



Catheter Related Endocarditis



Surgical Considerations for Infective Endocarditis

- Indications for surgery
- Timing of surgery
- Surgical procedures

Indications for Surgery

- Heart failure
- Uncontrolled infection
- Prevention of embolism

Timing of Surgery

- Emergency: within 24 hours
- Urgent: within a few days
- Elective: after 1-2 weeks of antibiotic therapy

Goals of Surgery

- Complete removal of infected tissues
- Restoration of hemodynamic abnormality

Available Guidelines

- AHA guideline for infective endocarditis in adults (2015)
- AHA guideline for infective endocarditis in childhood (2015)
- AHA/ACC guideline for the management of patients with valvular heart disease (2014)
- ESC guidelines on the prevention, diagnosis, and treatment of infective endocarditis (2009)
- STS clinical practice guideline for surgical management of endocarditis (2011)

PRACTICE GUIDELINE

2014 AHA/ACC Guideline for the Management of Patients With Valvular Heart Disease: Executive Summary



A Report of the American College of Cardiology/American Heart Association
Task Force on Practice Guidelines

*Developed in Collaboration With the American Association for Thoracic Surgery,
American Society of Echocardiography, Society for Cardiovascular Angiography and Interventions,
Society of Cardiovascular Anesthesiologists, and Society of Thoracic Surgeons*

The First Step

- Cardiothoracic surgical consultation should be obtained rapidly after the diagnosis of infective endocarditis.
- Decisions about timing of surgical intervention should be made by a multispecialty Heart Valve Team of cardiology, cardiothoracic surgery, and infectious disease specialists.

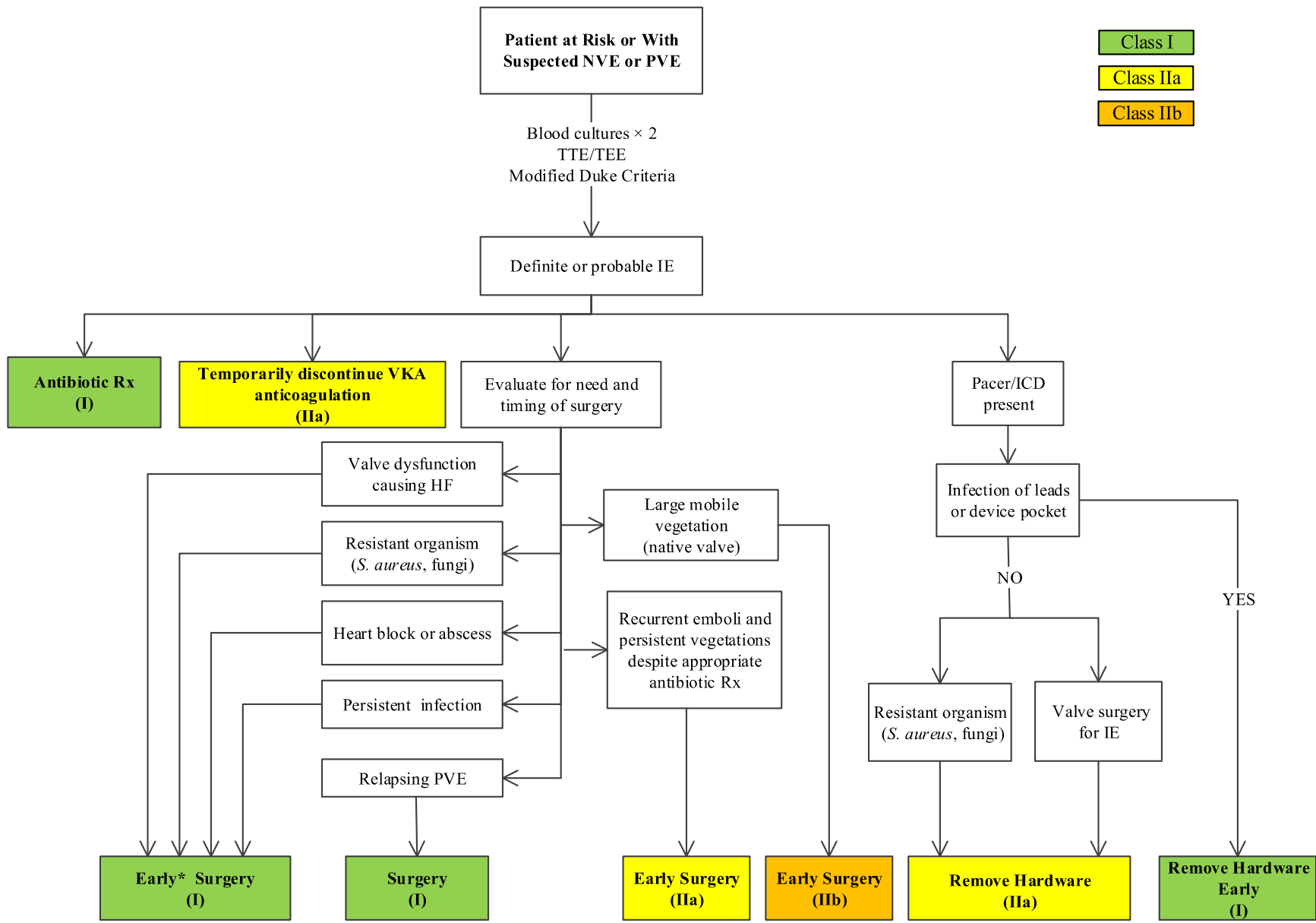


Figure 9. Diagnosis and Treatment of IE

AHA Scientific Statement

Infective Endocarditis in Adults: Diagnosis, Antimicrobial Therapy, and Management of Complications **A Scientific Statement for Healthcare Professionals From the American Heart Association**

Endorsed by the Infectious Diseases Society of America

Larry M. Baddour, MD, FAHA, Chair; Walter R. Wilson, MD; Arnold S. Bayer, MD;
Vance G. Fowler, Jr, MD, MHS; Imad M. Tleyjeh, MD, MSc;
Michael J. Rybak, PharmD, MPH; Bruno Barsic, MD, PhD; Peter B. Lockhart, DDS;
Michael H. Gewitz, MD, FAHA; Matthew E. Levison, MD; Ann F. Bolger, MD, FAHA;
James M. Steckelberg, MD; Robert S. Baltimore, MD; Anne M. Fink, PhD, RN;
Patrick O’Gara, MD, FAHA; Kathryn A. Taubert, PhD, FAHA; on behalf of the American Heart Association Committee on Rheumatic Fever, Endocarditis, and Kawasaki Disease of the Council on Cardiovascular Disease in the Young, Council on Clinical Cardiology, Council on Cardiovascular Surgery and Anesthesia, and Stroke Council

Valve Surgery in Patients With Right-Sided Infective Endocarditis

- Surgical intervention is reasonable for patients with certain complications (Class IIa; Level C).
- Valve repair rather than replacement should be performed when feasible (Class I; Level C).
- If valve replacement is performed, then an individualized choice of prosthesis by the surgeon is reasonable (Class IIa; Level C).
- It is reasonable to avoid surgery when possible in patients who are injection drug users (Class IIa; Level C).

Valve Surgery in Patients With Prior Emboli/Hemorrhage/Stroke

- 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 B).
- In patients with major ischemic stroke or intracranial hemorrhage, it is reasonable to delay valve surgery for at least 4 weeks (Class IIa; Level B).

AHA Scientific Statement

Infective Endocarditis in Childhood: 2015 Update A Scientific Statement From the American Heart Association

Robert S. Baltimore, MD, Chair; Michael Gewitz, MD, FAHA, Vice Chair;
Larry M. Baddour, MD, FAHA; Lee B. Beerman, MD; Mary Anne Jackson, MD;
Peter B. Lockhart, DDS; Elfriede Pahl, MD, FAHA; Gordon E. Schutze, MD;
Stanford T. Shulman, MD; Rodney Willoughby, Jr, MD; on behalf of the American Heart Association
Rheumatic Fever, Endocarditis, and Kawasaki Disease Committee of the Council on Cardiovascular
Disease in the Young and the Council on Cardiovascular and Stroke Nursing

Infective Endocarditis in Childhood: 2015 Update

- Prophylactic surgery to prevent a primary embolic event is not recommended given the lack of proven benefit and long-term risks of valve replacement in childhood (Class III; Level C).
- Surgery may be considered for patients with relapsing prosthetic valve endocarditis even if valvar function remains intact after prolonged medical therapy (Class IIb; Level B).



European Heart Journal (2009) **30**, 2369–2413
doi:10.1093/eurheartj/ehp285

ESC GUIDELINES

Guidelines on the prevention, diagnosis, and treatment of infective endocarditis (new version 2009)

**The Task Force on the Prevention, Diagnosis, and Treatment of
Infective Endocarditis of the European Society of Cardiology (ESC)**

**Endorsed by the European Society of Clinical Microbiology and Infectious Diseases
(ESCMID) and by the International Society of Chemotherapy (ISC) for Infection and
Cancer**

Table 19 Indications and timing of surgery in left-sided native valve infective endocarditis

Recommendations: Indications for surgery	Timing*	Class ^a	Level ^b
A - HEART FAILURE			
Aortic or mitral IE with severe acute regurgitation or valve obstruction causing refractory pulmonary oedema or cardiogenic shock	Emergency	I	B
Aortic or mitral IE with fistula into a cardiac chamber or pericardium causing refractory pulmonary oedema or shock	Emergency	I	B
Aortic or mitral IE with severe acute regurgitation or valve obstruction and persisting heart failure or echocardiographic signs of poor haemodynamic tolerance (early mitral closure or pulmonary hypertension)	Urgent	I	B
Aortic or mitral IE with severe regurgitation and no HF	Elective	IIa	B
B - UNCONTROLLED INFECTION			
Locally uncontrolled infection (abscess, false aneurysm, fistula, enlarging vegetation)	Urgent	I	B
Persisting fever and positive blood cultures > 7–10 days	Urgent	I	B
Infection caused by fungi or multiresistant organisms	Urgent/elective	I	B
C - PREVENTION OF EMBOLISM			
Aortic or mitral IE with large vegetations (> 10 mm) following one or more embolic episodes despite appropriate antibiotic therapy	Urgent	I	B
Aortic or mitral IE with large vegetations (> 10 mm) and other predictors of complicated course (heart failure, persistent infection, abscess)	Urgent	I	C
Isolated very large vegetations (> 15 mm) [#]	Urgent	IIb	C

ORIGINAL ARTICLE

Early Surgery versus Conventional Treatment for Infective Endocarditis

Duk-Hyun Kang, M.D., Ph.D., Yong-Jin Kim, M.D., Ph.D.,
Sung-Han Kim, M.D., Ph.D., Byung Joo Sun, M.D., Dae-Hee Kim M.D., Ph.D.,
Sung-Cheol Yun, Ph.D., Jong-Min Song, M.D., Ph.D.,
Suk Jung Choo, M.D., Ph.D., Cheol-Hyun Chung, M.D., Ph.D.,
Jae-Kwan Song, M.D., Ph.D., Jae-Won Lee, M.D., Ph.D.,
and Dae-Won Sohn, M.D., Ph.D.

Table 3. Clinical End Points.

Outcome	Conventional Treatment (N = 39)	Early Surgery (N = 37)	P Value
Primary end point — no. (%)			
In-hospital death or embolic event at 6 wk	9 (23)	1 (3)	0.01
In-hospital death	1 (3)	1 (3)	1.00
Embolic event at 6 wk			
Any	8 (21)	0	0.005
Cerebral	5 (13)	0	
Coronary	1 (3)	0	
Popliteal	1 (3)	0	
Splenic	1 (3)	0	
Secondary end points at 6 mo — no. (%)			
Any	11 (28)	1 (3)	0.003
Death	2 (5)	1 (3)	1.00
Embolic event	8 (21)	0	0.005
Recurrence of infective endocarditis	1 (3)	0	1.00

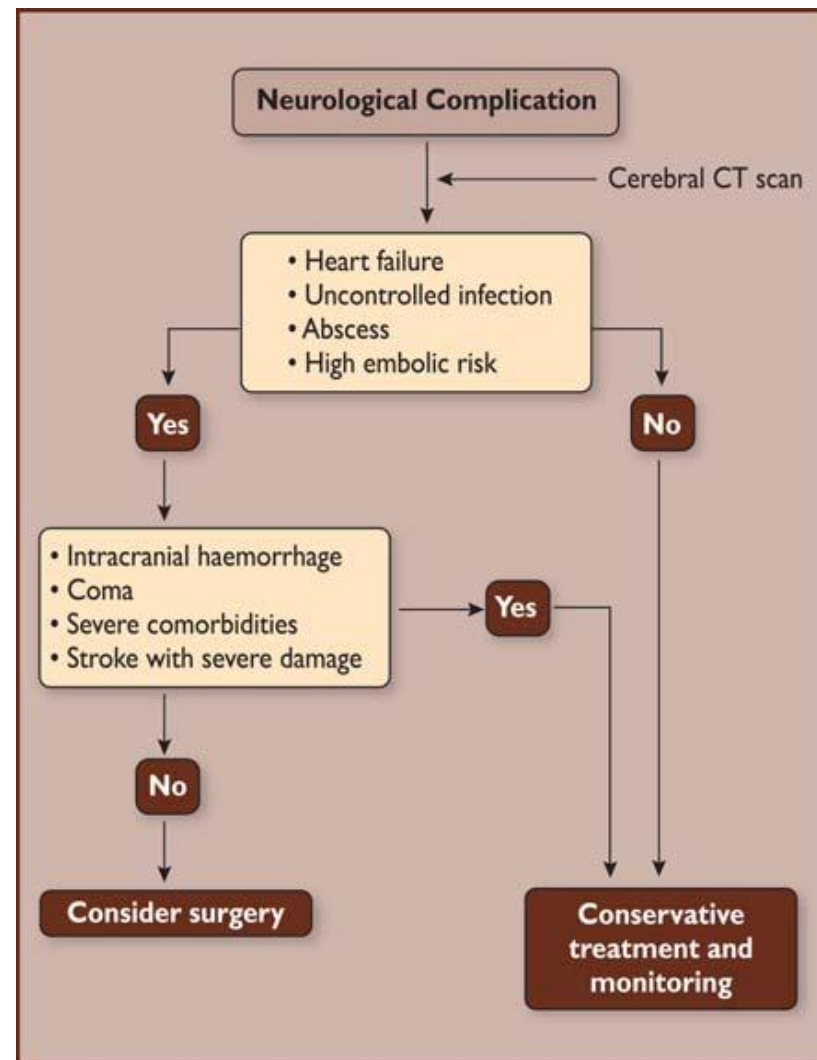


Figure 3 Therapeutic strategy for patients with infective endocarditis and neurological complications.

Table 24 Cardiac device-related infective endocarditis (CDRIE): treatment and prevention

Recommendations: IE on pacemakers and implantable defibrillators	Class ^a	Level ^b
A - PRINCIPLES OF TREATMENT:		
Prolonged antibiotic therapy and device removal are recommended in definite CDRIE	I	B
Device removal should be considered when CDRIE is suspected on the basis of occult infection without other apparent source of infection	IIa	C
In patients with native or prosthetic valve endocarditis and an intracardiac device with no evidence of associated device infection, device extraction may be considered	IIb	C
B - MODE OF DEVICE REMOVAL:		
Percutaneous extraction is recommended in most patients with CDRIE, even those with large (> 10 mm) vegetations	I	B
Surgical extraction should be considered if percutaneous extraction is incomplete or impossible or when there is associated severe destructive tricuspid IE	IIa	C
Surgical extraction may be considered in patients with very large (> 25 mm) vegetations	IIb	C
C - REIMPLANTATION:		
After device extraction, reassessment of the need for reimplantation is recommended	I	B
When indicated, reimplantation should be postponed if possible to allow a few days or weeks of antibiotic therapy	IIa	B
Temporary pacing is not recommended	III	C
D - PROPHYLAXIS		
Routine antibiotic prophylaxis is recommended before device implantation	I	B

^aClass of recommendation.

^bLevel of evidence.

Surgical Management of Endocarditis: The Society of Thoracic Surgeons Clinical Practice Guideline

John G. Byrne, MD, Katayoun Rezai, MD, Juan A. Sanchez, MD, MPA, Richard A. Bernstein, MD, PhD, Eric Okum, MD, Marzia Leacche, MD, Jorge M. Balaguer, MD, Shyam Prabhakaran, MD, MS, Charles R. Bridges, MD, ScD, and Robert S. D. Higgins, MD, MSHA

Department of Cardiac Surgery, Vanderbilt University Medical Center, Nashville, Tennessee; Division of Infectious Diseases, Rush University, Chicago, Illinois; Department of Surgery, Saint Mary's Hospital, Waterbury, Connecticut; Feinberg School of Medicine of Northwestern University, Northwestern Memorial Hospital, Chicago, Illinois; Cardiac Vascular and Thoracic Surgeons, Cincinnati, Ohio; Department of Surgery, University of Pennsylvania Medical Center, Philadelphia, Pennsylvania; Department of Cardiovascular-Thoracic Surgery, Rush University Medical Center, Chicago, Illinois; and Division of Cardiac Surgery, The Ohio State University Medical Center, Columbus, Ohio

Native Aortic Valve Endocarditis

- A mechanical or stented tissue valve is reasonable in native aortic valve endocarditis. (Class IIa, Level B)
- A homograft may be considered in native aortic valve endocarditis. (Class IIb, Level B)

Prosthetic Aortic Valve Endocarditis

- In patients with aortic PVE limited to the prosthesis without aortic root abscess, and no annular destruction, it is reasonable to implant a mechanical or stented tissue valve. (Class IIa, Level B)
- A homograft can be beneficial in aortic PVE when periannular abscess or extensive ventricular-aortic discontinuity is present, or when aortic root replacement/reconstruction is necessary because of annular destruction or destruction of anatomical structures. (Class IIa, Level B)

Native Mitral Valve Endocarditis

- When technically feasible, mitral valve repair is recommended to treat native mitral valve endocarditis. (Class I, Level B)
- When surgery is indicated, mechanical or stented tissue valves can be useful for mitral valve replacement. (Class IIa, Level B)

Prosthetic Mitral Valve Endocarditis

- When surgery is indicated for prosthetic mitral valve endocarditis, either mechanical or stented tissue valves may be considered for valve replacement. (Class IIb, Level C)

Outcomes of Surgical Therapy for Infective Endocarditis in a Pediatric Population: A 21-Year Review

Hyde M. Russell, MD, Soraya L. Johnson, BS, Katherine C. Wurlitzer, BA, and Carl L. Backer, MD

Division of Cardiovascular-Thoracic Surgery, Ann & Robert H. Lurie Children's Hospital of Chicago, and Department of Surgery, Northwestern University, Feinberg School of Medicine, Chicago, Illinois

Background. Infective endocarditis is a rare disease in the pediatric population. We sought to define patient characteristics and outcomes of surgical therapy for endocarditis in children.

Methods. We performed a retrospective review of all patients with infective endocarditis who received surgical therapy between January 1, 1990, and March 1, 2011. We were interested in their congenital heart defect, prior surgical procedures, and outcome of the operation.

Results. We identified 35 cases of endocarditis in 34 patients requiring surgical intervention. Mean age was 10.7 ± 8.8 years. There was a bimodal age distribution at presentation: 11 (31%) were younger than 1 year and 15 (43%) were 10 to 21 years. Of the 34 patients, 22 (63%) had no history of prior cardiac operation. The infective organism was identified in 30 (86%), with *Staphylococcus aureus* (n = 8) and *Streptococcus viridans* (n = 6) predominating. Valve replacement was performed in 22 patients and valve repair in 10. All patients received 6 weeks of postoperative intravenous antimicrobial therapy.

Operative mortality was 15% (5 of 34). The 5 deaths occurred in infants who were a mean age of 2.5 months, and 3 of the 5 infants (60%) were premature. Of 4 patients with fungal infection, 3 patients died. The Ross operation was performed successfully in 5 patients with severe aortic valve disease. Reoperations (n = 10 [28%]) included valve replacement in 5 and conduit replacement in 3, all but 1 due to somatic growth resulting in functional stenosis.

Conclusions. The outcome of surgical therapy for endocarditis in children was similar to that reported for adults, with an overall mortality of 15%. The Ross operation was very effective in patients with aortic valve endocarditis. There is a significant incidence of late reoperation for valve and conduit replacement due to somatic growth. Age younger than 1 year, prematurity, and fungal organisms appear to be risk factors for death. Patients surviving to discharge had good outcomes, with no episodes of recurrent endocarditis.

(Ann Thorac Surg 2013;96:171-5)

© 2013 by The Society of Thoracic Surgeons

Chicago Experience

- N = 34
- Mean age of 10.7 years
- 60% congenital heart disease
- MV > AV > TV > RV-PA conduit
- Native > prosthetic
- Replacement > repair > Ross
- 15% operative mortality
(infants, prematurity, fungus)

CONGENITAL HEART DISEASE

Early surgical therapy of infective endocarditis in children: A 15-year experience

Pirouz Shamszad, MD,^a Muhammad S. Khan, MD,^b Joseph W. Rossano, MD,^c and Charles D. Fraser, Jr, MD^b

Objectives: Infective endocarditis is rare in children but potentially carries high mortality and morbidity. Few data exist regarding surgical therapy and the associated outcomes in children with infective endocarditis. The aim of the present study was to describe the characteristics and outcomes of children undergoing surgery for infective endocarditis.

Methods: A retrospective review of all patients aged 21 years or younger diagnosed with definitive infective endocarditis at a single center from 1996 to 2010 was performed.

Results: Of 76 identified patients with infective endocarditis (median age, 8.3 years; 73.9% boys), 46 patients (61%) required surgical intervention. *Staphylococcus aureus* was most commonly isolated (18 patients, 24%) followed by *Streptococcus* (17 patients, 22%). Common surgical indications included severe valvular insufficiency in 13 patients, septic embolization in 12, concomitant severe valvular insufficiency and ventricular dysfunction in 9, persistent vegetations in 9, and persistent bacteremia in 3. Although early surgery was performed within 7 days of diagnosis in 35 patients (76%), 25 (54%) underwent surgery within 3 days or less. The factors associated with surgery included the presence of ventricular dysfunction, left-sided vegetation, severe valvular insufficiency, septic embolization, and *S aureus*. Surgery within 3 days or less was associated with the presence of ventricular dysfunction and *S aureus*. Native valve repair was performed in 50% of patients with native-valve disease. Postoperatively, no septic embolization events occurred and recurrence was low (2%). The 1-, 5-, and 10-year survival was 98% ± 2%, 90% ± 8%, and 81% ± 11%, respectively.

Conclusions: Children with infective endocarditis can undergo successful early surgical therapy with a low risk of septic embolization, recurrence, and operative mortality. (J Thorac Cardiovasc Surg 2013;146:506-11)

Texas Experience

- N = 46
- Median age of 8.7 years
- 54% congenital heart disease
- TV > MV > AV > RV-PA conduit
- Native > prosthetic
- 76% early surgery (< 7 days of the diagnosis)
- Repair > replacement > Ross
- 2% operative mortality
- 10-year survival of 81%

Risk factors for development of endocarditis and reintervention in patients undergoing right ventricle to pulmonary artery valved conduit placement

Carlos M. Mery, MD, MPH,^a Francisco A. Guzmán-Pruneda, MD,^a Luis E. De León, MD,^{a,b} Wei Zhang, PhD,^c Matthew D. Terwelp, BS,^d Claire E. Bocchini, MD,^e Iki Adachi, MD,^a Jeffrey S. Heinle, MD,^a E. Dean McKenzie, MD,^a and Charles D. Fraser, Jr, MD^a

RV-PA Conduit Endocarditis

- Bovine jugular vein grafts (Contegra) are associated with a 9-fold greater risk of late endocarditis compared with other RV-PA conduits.

Incidence and outcomes of right-sided endocarditis in patients with congenital heart disease after surgical or transcatheter pulmonary valve implantation

Sophie Malekzadeh-Milani, MD, Magalie Ladouceur, MD, Laurence Iserin, MD, Damien Bonnet, MD, PhD, and Younes Boudjemline, MD, PhD

Objectives: To evaluate right-sided endocarditis and compare the incidence, clinical presentations, and outcomes in patients with a surgical and percutaneous pulmonary valve.

Methods: All patients with infective endocarditis occurring between January 2009 and June 2013 were identified and studied. All consecutive patients who received a pulmonary valve surgically or by percutaneous pulmonary valve implantation (PPVI) during the same period were also evaluated for endocarditis.

Results: During the study period, 31 patients were identified with right-sided endocarditis: 13 had valves implanted during the study period and 18 before. The person-time incidence rates of endocarditis were 1.2 and 3.9 cases/100 person-years in the surgical and PPVI groups, respectively ($P = .03$). Clinical presentations, microbiology, and outcomes were comparable in both groups. The implantation-endocarditis time interval was much shorter in the patients in the PPVI group ($P = .0065$). A past history of endocarditis was found to correlate with endocarditis ($P = .004$). Infective endocarditis was more frequent in patients with bovine jugular vein valves compared with others (7.1% vs 0.84%, $P = .0117$; odds ratio, 9). Probability of survival at 12, 24, and 36 months was 99.5%, 93.8%, 93.8% in the surgical group and 98.9%, 96.8%, 92.3% in the PPVI group, respectively ($P = .6$). Event-free probability including endocarditis was comparable ($P = .1$).

Conclusions: There is a higher incidence of endocarditis in patients with PPVI compared with surgical pulmonary valves. Clinical and biological features were comparable in both groups. The role of bovine jugular veins in the development of endocarditis is concerning. However, despite a higher incidence of endocarditis in the PPVI group, the probabilities of survival and event-free survival were similar to the surgical group. (J Thorac Cardiovasc Surg 2014;148:2253-9)

Percutaneous PV Endocarditis

- There is a higher incidence of endocarditis in patients with percutaneous pulmonary valve (Melody) implantation compared with surgical pulmonary valves.
- When analyzing the type of valves regardless of the implantation technique, IE was more frequent in patients with bovine jugular vein valves (ie, Contegra and Melody) compared with others.

Summary

1. Guidelines for surgical management of pediatric IE are mostly an extension of guidelines for management of adult IE.
2. Decisions regarding surgery for IE are complex and should be determined by a multispecialty team with expertise in cardiology, imaging, cardiothoracic surgery, and infectious diseases.
3. Proper patient selection and optimal surgical timing are crucial for improved outcomes.
4. There is an increased risk of endocarditis in patients receiving a bovine jugular vein valve either surgically (Contegra) or by the transcatheter technique (Melody).