INFECTIVE ENDOCARDITIS: CURRENT SCENARIO

ABSTRACT
The definite incidence of Infective Endocarditis in Indian population is not available but the estimated incidence in western population is stationary over two decades.

Normal valve endocarditis is an established entity due to emerging Risk factors.

Strephlococci and Staphylococci are the commonest organisms involved in IE and responsible for 80% of cases. Streptococcus viridians is responsible for 30 to 65% of Native valve Endo Carditis (NVE) in India though Staphylococcus incidence is on the raise. Enterococi, poly microbial IE & fungi are also often recognised.

Blood culture is often negative in Indian Population compared to western often due to prior anti microbial therapy. Rare organism may also be the cause.

Transesophageal Echo is superior to Trans thoracic Echo in locating the vegetations, predicting & confirming the Cardiac complication of IE.

Modified Duke’s criteria is recommended as the primary scheme for the diagnosis of IE.

Newer diagnostic modalities like Serology, Agglutination, Immunofluorescence, PCR, Procalcitonin are useful in rare infections & culture negative Endocarditis.

Newer & Effective antimicrobials are available for NVE & PVE but still the mortality is around 40%

Surgery plays a major role in persistent endocarditis & may be life saving.

American Heart Association has recently issued the new simple recommendation for IE propylaxis stressing good oral hygiene.

Future perspectives in diagnosis, anti microbials, vaccines & prosthetic materials are encouraging.

DEFINITION
Infective endocarditis is defined as microbial infection of the endothelial surfaces of the heart or iatrogenic foreign bodies like prosthetic valves, and other intracardiac devices. Commonly involves heart valves but may occur at sites of septal defects chordae tendinae or mural endocardium. May also occur at AV shunts,arterioarterial shunts (PDA) or coarctation of Aorta - Infective Endoarteritis.
Table: Duke criteria for the diagnosis of infective endocarditis and modifications

<table>
<thead>
<tr>
<th>Duke's criteria</th>
<th>Modifications Suggested</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pathological criteria:</strong></td>
<td></td>
</tr>
<tr>
<td>Microorganisms demonstrated by culture or histological examination</td>
<td></td>
</tr>
<tr>
<td>Active endocarditis demonstrated by histological examination</td>
<td></td>
</tr>
<tr>
<td>Major Criteria</td>
<td></td>
</tr>
<tr>
<td>Positive blood cultures</td>
<td></td>
</tr>
<tr>
<td>Typical microorganisms consistent with endocarditis from two separate blood cultures.</td>
<td></td>
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<tr>
<td>Microorganisms consistent with endocarditis from persistently positive blood cultures.</td>
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<tr>
<td>Evidence of endocardial involvement:</td>
<td></td>
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<tr>
<td>Oscillating structures, Abscessformation</td>
<td></td>
</tr>
<tr>
<td>New partial dehiscence of prosthetic valve</td>
<td></td>
</tr>
<tr>
<td>New Valvular regurgitation</td>
<td></td>
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<tr>
<td><strong>Minor Criteria:</strong></td>
<td></td>
</tr>
<tr>
<td>Predisposing heart disease</td>
<td></td>
</tr>
<tr>
<td>Fever &gt;38°C</td>
<td><em>To be omitted</em></td>
</tr>
<tr>
<td>Vascular phenomena</td>
<td></td>
</tr>
<tr>
<td>Immunological phenomena</td>
<td></td>
</tr>
<tr>
<td>Microbiological evidence (not meeting major criterion)</td>
<td></td>
</tr>
<tr>
<td>Suspect echocardiography (not meeting major criterion)</td>
<td></td>
</tr>
<tr>
<td>Predisposing heart disease</td>
<td></td>
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<tr>
<td><strong>Categories</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Definite IE:</strong></td>
<td></td>
</tr>
<tr>
<td>Pathological criteria</td>
<td></td>
</tr>
<tr>
<td>or 2 major criteria positive</td>
<td></td>
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<tr>
<td>or 1 major and 2 minor criteria positive</td>
<td></td>
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<tr>
<td>or 5 minor criteria positive</td>
<td></td>
</tr>
<tr>
<td><strong>Possible IE:</strong></td>
<td></td>
</tr>
<tr>
<td>All cases which cannot be classified as</td>
<td></td>
</tr>
<tr>
<td>definite or rejected</td>
<td></td>
</tr>
<tr>
<td><strong>Rejected IE:</strong></td>
<td></td>
</tr>
<tr>
<td>Firm Alternating diagnosis.</td>
<td></td>
</tr>
<tr>
<td>Resolution of the infection with antibiotic treatment for &lt; 4 days.</td>
<td></td>
</tr>
<tr>
<td>No histological evidence of surgery or autopsy after 4 days of antibiotic therapy or less</td>
<td></td>
</tr>
</tbody>
</table>

**Emerging Risk factors include:**

- Increased longevity has added the burden of degenerative heart disease to IE
- Medical instrumentation of Gastrointestinal, Genitourinary Etc.,
- Invasive therapeutic procedures – Intracardiac Pacemaker, ICD, AV fistula
- Immunosuppressive therapy
- Immune compromised states – HIV, uncontrolled diabetes etc.,
- IV drug abuse

Hence in India we are facing the Traditional IE due to R.H.D and

**Modern IE on Normal Heart Valves.**

**Microbiological Profile**

- In developing countries like India where RHD is more prevalent, streptococci viridians is still the commonest.
- Other Streptococcal species seen include S.sanguis, S.bovis, S.mutans, S.mitis etc seen in elderly.
- Staphylococcus aureus is a single most common cause of IE in health care associated endocarditis – 40% Can invade intact endothelium.
- Gram negative endocarditis include pseudomonas aeruginasa & HACEK group Cause NVE & PVE usually subacute(haemophilus parainflunzae, hemophilus aphrophilus, actinobaillus actinomy ctemcomitans, cardio-
bacterium, hominis, eikenella carrohens and kingella kingae)

- Enterococcal IE is becoming common due to instrumenta-
tion of Genito Urinary, GI
- Polymicrobial IE though rare, often seen in IV drug users.
- The newer risk factors increase the risk of infection by
  fastidious and atypical organisms. Such pathogens include
  Coxiella burnetti, Legionella spp, Chlamydia, Mycoplasma,
  Streptobacillus moniliformis, Salmonella, Brucella, Barton-
  ella, Tropheryma Whippelii. It is noteworthy that despite a
  large agricultural population, and large livestock and zoonosis, IE
  with Coxiella, Brucella, and Salmonella typhimurium are rarely
diagnosed and perhaps missed in India. Since they cannot be
  cultivated in conventional culture media Bacterial culture
  negative infective endocarditis (BCNE) is emerging as a new
  problem.
- Common fungi are Candid albicans, Aspergillosis, Histoplas-
  mosis when immunocompromised. Often seen in health
  care associated endocarditis & PVE.

Clinical features have not changed much

Triad of Heart Murmur, Fever, Splenomegaly still holds good. High
index of clinical suspicion is the corner stone of early diagnosis.
New changing Regurgitant murmur is the hall mark of IE.

Classical peripheral of manifestation of IE- petechiae, splinter
haemorrhages, oslers nodes, Janeway lesions are still common

Embolic phenomena include systemic, cerebral and pulmonary
emboli are common in more than 50% of cases. Embolic features
are commonly seen into CNS as embolic stroke, Intra cerebral
haemorrhages, cerebellar abscess, mycotic aneurysm, seizures
and encephalopathy. May be present as pulmonary embolism
also. Cardiac complication include congestive heart failure,
conduction defects, abscess, purulent pericarditis and functional
valvular stenosis. Perforation of valves or rupture of Chordae is
the cause for new Regurgitant Murmur. Renal dysfunction is also
common complication in India.

Duke's Vs Modified Duke’ s criteria

Time honours Duke's criteria is yielding a sensitivity of only 76%
in the diagnosis of IE. Major deficiency of the schema is inability
to diagnose BCNE. Recently modified Duke's criteria has been
accepted as the diagnostic schema for IE by AHA/ACC. Major
additions include Q fever serology, staphylococcal bacteremia in
the absence of other primary focus as major criteria, serological
evidence of active infection by other organism consistent with
endocarditis as minor criteria. Possible IE is diagnosed in the
presence of 1 major + 1 minor or 3 minor criteria are positive.

DIAGNOSIS –CURRENT STATUS

Problems:

Duke's criteria since the day of it's introduction (1994) remains
as the cornerstone for the diagnosis of IE, In which positive
blood culture, echocardiograph evidence of vegetations is the 2
major criteria. If strictly taken as per the guidelines (3 separate
venepunctures during 1hr period at least 10ml of blood) before
giving antibiotics the blood culture will detect the organisms in
more than 90% of the cases. But the adherence to the guidelines
is poor and nearly up to 30% were prescribed antibiotic therapy
before the diagnostic work up. Hence negative blood cultures
are increasing and have been reported in nearly 2.5%-31% of all
cases of infective endocarditis'.

Possible reasons for BCNE are,

1. Antibiotic therapy before blood culture
2. Fastidious or atypical organisms do not grow in routine cul-
ture media
3. Fungal or viral endocarditis (very rare)

Echocardiography:
Identification of a Vegetation is one of two major criteria for IE

Typical Echo features:

1. Oscillating intra cardiac mass on a valve or supporting
   structure or device or in the path of a regurgitant stream.
2. Abscess.
3. New Partial dehiscence of PV.

Echo is useful in predicting complications based on the size of
the vegetation, mobility, extent & consistency, either embolization
or local destruction.

Vegetations greater than 10mm often embolise.

TRANSTHORACIC ECHO (TTE)

Case of VSD and Aortic Valve Repair: Vegetation above the AV at
suture site.

TRANS ESOPHAGEAL ECHO (TEE)

Trans Esophageal Echo is superior to TTE, it can detect structures
upto 1mm in size. Even very small vegetations, valve perforations,
abscess can be visualized. Pulmonic and prosthetic valve lesion
are also better visualized than in TTE. It has 87%-100% sensitivity
and specificity between 91%-100%. At the same time negative
TEE will not exclude the diagnosis. As per the new guidelines TEE
Infective Endocarditis: Current Scenario

**MOLECULAR & SEROLOGICAL TESTS**

Although the studies from western countries are reporting sterile blood culture in up to 31%, the figures are as high as 48%-54%\(^1\) in developing countries like India. In patients with previous antibiotic therapy, the yield of blood culture can be enhanced by diluting the culture broth and adding sodium polyanetholsulfonate or a dedicated adsorbent resin, both of which inactivate antimicrobial effects. In the absence of previous antibiotic therapy we must think of fastidious slow growing organisms as etiology and subculture into chocolate agar may allow identification of those atypical organisms. Delay in making the diagnosis and introducing appropriate antibiotic therapy will drastically reduce the survival rate from 92% - 50%. So what we need now is newer techniques which identifies the organisms earlier (with in 24 hrs) and correctly.

**SEROLOGY**

For the diagnosis of fastidious, slow-growing (*Brucella* and *Bartonella* species) and cell-dependent pathogens (*C. burnetii*) substantial data are there to support the use of serological tests in the routine diagnosis. Endocarditis presents only during the chronic infection with *C. burnetii*, a time when antibody levels could be anticipated to be elevated. In the context of endocarditis, The demonstration of Phase I IgG titer (>1:800) by indirect immunofluorescence technique is the reference method for the serological diagnosis of *C. burnetii* and *Bartonella* species. It has been proved as to be the most successful; and has been shown to be highly predictive (98%) and sensitive (100%) for *C. burnetii* endocarditis. For *Bartonella* species also, it has high sensitivity (100%) and specificity (99.5%), although there must be a note of caution. There are documented instances of cross-reactivity being observed between *C. burnetii*, *Bartonella* and *Chlamydia* species.\(^7\), \(^8\) Tests are also available or under investigation for the other organisms implicated in endocarditis at a lower incidence; like *Legionella*, *Mycoplasma*, *Chlamydia* and *Brucella*. Positive serology for *C. burnetii*, is now recognized as a major criterion of the modified Duke scheme. Despite having a lower positive predictive value and the potential for cross-reaction serology is having a proven role in the diagnosis of BCNE\(^9\). Not only that serological test which focused to detect antigens (peptidoglycan, lipoteichoic acid, \(\alpha\)-toxin) of common pathogens like staphylococci, streptococci also available. They are valuable for identifying the organism in whom blood cultures remain sterile because of prior antibiotic therapy. But, currently the staphylococcal serology is not recommended as routine.

**MOLECRULAR TECHNIQUES**

Molecular diagnosis is based on the amplification and detection of nucleic acid of infecting organism by polymerase chain reaction. A milestone publication in 1997 by Goldenberger et al. opened the way to numerous studies to assess the utility of PCR in the routine diagnosis of endocarditis. There can be no doubt that the use of PCR amplification of prokaryotic 16S r DNA has invaluable

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**Legend for the Flowchart:**

- **IE** = infective endocarditis; **PCR** = polymerase chain reaction.
- if the organism remains unidentified and the patient is stable, consider antibiotic withdrawal and repeat blood cultures.

### Decision Tree for Diagnosis of IE

<table>
<thead>
<tr>
<th>Positive cultures</th>
<th>Clinical/echo picture suggests IE?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>Start antibiotic therapy as appropriate</td>
</tr>
<tr>
<td></td>
<td>Need for surgery</td>
</tr>
<tr>
<td></td>
<td>Reassess patient &amp; consider alternative diagnosis</td>
</tr>
<tr>
<td></td>
<td>Medical treatment</td>
</tr>
<tr>
<td></td>
<td>Send excised valve/embolic material for pathology, Gram stain, culture &amp; cryopreservation for possible PCR</td>
</tr>
<tr>
<td></td>
<td>Liaise with Microbiology lab Consider additional investigations</td>
</tr>
<tr>
<td></td>
<td>Treat as culture negative IE with regimen to cover likely organisms* (Switch to correct regimen once organism identified)</td>
</tr>
<tr>
<td></td>
<td>Reassess patient &amp; consider alternative diagnosis</td>
</tr>
</tbody>
</table>

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*A if the organism remains unidentified and the patient is stable, consider antibiotic withdrawal and repeat blood cultures.*
role in the demonstration of bacteria within heart valve material. It not only helps to detect the non-cultivable organisms, the sensitivity of the test is also not affected by the prior antibiotic treatment. Evidence from three studies has indicated that the positive and negative predictive values for PCR versus culture were 100Vs 75-87%, and finally 34.8-90Vs 24-56%, respectively. In addition, to a high level of accuracy, the results can be generated within hours.

Detection limit of PCR 5-15cfu/PCR reaction but the level of bacteremia in a patient with IE is 1-10cfu/ml of blood, well below the detection limit. Currently the newer PCR techniques like nested PCR, RT-PCR, Lightcycler technology can be used to detect organism in blood sample also in addition to tissues. Raoul et al. have recently published work, evaluating a proteomic approach (protein signatures of the organism used to identify the pathogen) into the diagnosis of BCNE specifically Tropheryma and other difficult to isolate pathogens.

Pro calcitonin has been shown as a marker for IE. Values exceeding 2.3 ng/ml in a suspected case of IE has a sensitivity of 81% & specificity of 85% in diagnosing definite IE.

INDIAN SCENARIO

Blood culture is positive only in 67.7% of the cases even in recently published study from India. TEE, molecular diagnostic methods are not widely available. Modified Duke’s criteria not tested in Indian set up. Inclusion of elevated erythrocyte sedimentation rate or C-reactive protein (CRP), the presence of newly diagnosed clubbing, splenomegaly and microscopic hematuria as minor criteria (St Thomas modifications) has been shown to increase the sensitivity by 10% without significant loss of specificity in the Western setting. Such inclusions may be more appropriate in our patient population because of larger number of patients manifesting these criteria, but they have not been part of modified Dukes criteria scheme. A recent study compared these modifications in pathologically proven yet culture negative cases. Only 21% were classified as definite by the original Duke criteria, while 32% were definite by the modified Duke criteria, and the St Thomas modifications classified 62% correctly.

TREATMENT

A: Antimicrobial Therapy

Therapeutic Principles

1. Bactericidal antibiotics are the choice.
2. High concentration of appropriate antibiotics in serum are necessary.
3. Long term therapy is required to kill the dormant bacteria.

Before sensitivity reports available empirical antibiotic therapy should be initiated based on clinical and epidemiological clues to the etiology. In the cases of native valve endocarditis, Penicillin G 12-18 million units per day in 4 divided doses or Ceftriaxone 2g iv single dose. Otherwise either of these 2 drugs with Gentamycin are the initial choice. With effective antibiotic therapy blood cultures become sterile with in 2 days, fever resolves with in 4-7 days. If fever persists despite 7 days of antibiotics patients should be evaluated for paravalvular or extracardiac abscess.

ANTIMICROBIAL PROTOCOL

<table>
<thead>
<tr>
<th>Drug</th>
<th>Dosage &amp; Route</th>
<th>Duration (Week)</th>
</tr>
</thead>
<tbody>
<tr>
<td>STREPTOCOCCUS</td>
<td>12-18 millions 24 hrs IV</td>
<td>4</td>
</tr>
<tr>
<td>Pencillin G Or</td>
<td>2gm IVOD</td>
<td>4</td>
</tr>
<tr>
<td>Gentamycin</td>
<td>3mg/kg/dosage IV</td>
<td>2</td>
</tr>
<tr>
<td>Ceftriazone</td>
<td>30mg/kg/2ghr IV</td>
<td>4</td>
</tr>
<tr>
<td>Vancomycin</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. S.VIRIDANS RESISTANT TO PENCILLIN G</td>
<td>24 millions/ 24 hr IV</td>
<td>4</td>
</tr>
<tr>
<td>a. Pencillin G Or</td>
<td>2gm IV daily</td>
<td>2</td>
</tr>
<tr>
<td>b. Ceftriazone+Gentamycin</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Enterococci</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Pencillin G + Gentamycin</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. Ampicillin + Gentamycin</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c. Vancomycin +</td>
<td>18-30 millions 24 hrs IV</td>
<td>4-6</td>
</tr>
<tr>
<td>Gentamycin</td>
<td>1mg IV/ kg every 8 hrs</td>
<td></td>
</tr>
<tr>
<td></td>
<td>12 g / 24 hrs IV</td>
<td></td>
</tr>
</tbody>
</table>

4. STAPHYLOCOCCUS

METHICILLIN SUSCEPTIBLE

a. Nafcillin or oxacillin + Gentamycin 1mg/kg/IV every 8 hours 6 weeks
b. Cefazolin + Gentamycin 1mg/kg/IV every 8 hours 6 weeks
c. Vancomycin M ETHICILLIN

Resistant
d. Vancomycin 2g IV every 4 hours 4-6 weeks
B. PVE 1mg IV every 8 hours 3-5 days

STAPHYLOCOCCUS

MRSA:

a. Vancomycin + Rifampicin + Gentamycin 30mg/kg/24 hrs IV 4-6 weeks

METHICILLIN SUSCEPTIBLE

Nafcillin or Oxacillin + Rifampicin + Gentamycin

HACEK ORGANISM

a. Ceftriaxone 30mg Po every 8 hrs 76 weeks
b. Ampicillin+ Sulbactam 1mg/kg IV every 8 hours 2 weeks

<table>
<thead>
<tr>
<th>Drug</th>
<th>Dosage &amp; Route</th>
<th>Duration (Week)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vancomycin</td>
<td>12g/2Hrs IV every 4 hours</td>
<td>4-6 weeks</td>
</tr>
</tbody>
</table>

IE due to rare microbes will respond to Doxycycline & Rifampin or Cotrimoxazole & quinolone for 3 months.

Eq: Brucella, C. Burnetti, Bartonella, Chlamydia, Mycplasma, Legionella, T. Whippelli.
Infective Endocarditis: Current Scenario

**Table 2: Indications for Surgical Intervention**

<table>
<thead>
<tr>
<th>Timing</th>
<th>Strong supporting Evidence</th>
<th>Conflicting Evidence, but Majority of opinion favor surgery</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emergent (Same day)</td>
<td>Acute aortic regurgitation plus preclosure of mitral valve sinus of valsalva abscess ruptured into right heart. Rupture into pericardial sac.</td>
<td>Major embolus plus persisting large vegetation (&gt; 10 mm in diameter).</td>
</tr>
<tr>
<td>Urgent (Within 1-2 days)</td>
<td>Valve obstruction by vegetation Unstable (Dehisced) prosthesis. Acute aortic or mitral regurgitation with heart failure. (New York Heart Association class III or IV). Septal perforation. Perivalvular extension of infection with / without new electrocardiographic conduction system changes. Lack of effective antibiotic therapy.</td>
<td>Staphylococal PVE Early PVE (≤ 2 months after valve surgery). Fungal endocarditis (Candida spp.). Antibiotic-resistant organisms.</td>
</tr>
<tr>
<td>Elective (Earlier usually preferred)</td>
<td>Progressive paravalvular prosthetic regurgitation. Valve dysfunction plus persisting infection after ≥ 7-10 days of antimicrobial therapy. Fungal (mold) endocarditis.</td>
<td></td>
</tr>
</tbody>
</table>

**Table 3: Cardiac Conditions Associated with the Highest Risk of Adverse Outcome from Endocarditis for which Prophylaxis with Dental Procedures is Reasonable**

- Prosthetic cardiac valve or prosthetic material used for cardiac valve repair
- Previous IE
- Surgically constructed systemic or pulmonary shunt or conduits.
- Complex cyanotic congenital heart disease
- Cardiac transplantation recipients who develop cardiac valvulopathy
- Moderate Risk:
  - Most other CHD (except isolated ostium secundum ASD)
  - Acquired valvular dysfunction
  - Hypertrophic cardiomyopathy
  - MVP with MR &/or thickened leaflets.

**PROPHYLACTIC THERAPY: CURRENT SCENARIO**

AHA/ACC has recently revised the 1997 guidelines and issued new dramatically restricted guidelines for the prophylaxis of IE. **New guidelines recommend prophylaxis only for cardiac conditions associated with high risk of adverse outcome from endocarditis**, not as the previous one which advised prophylaxis for cardiac conditions which has moderate to high risk for developing endocarditis. Based on the current one, IE prophylaxis recommended only for the dental procedures which involves manipulation of gingival tissue periapical region of tooth or perforation of oral mucosa.

Antibiotic prophylaxis indicated for invasive procedure of the respiratory tract that involves incision or biopsy of the respiratory mucosa, such as tonsillectomy and adenoidectomy, **not recommended for bronchoscopy unless the procedure involves incision of the respiratory tract mucosa**. The administration of prophylactic antibiotics solely to prevent endocarditis is **not recommended for the patients who undergo GU or GI tract procedures, including diagnostic esophagogastroduodenoscopy (OGD) or colonoscopy**.

For patients with the conditions listed in Table 3, who have an established GI or GU tract infection or for those who receive antibiotic therapy to prevent wound infection or sepsis associated with a GI or GU tract procedure, it may be reasonable that the antibiotic regimen include an agent active against enterococci, if a high-risk patients undergo surgical procedure that involves infected skin, skin structure, or musculoskeletal tissue, the therapeutic regimen administered for treatment of the infection should contain an agent active against staphylococci and β-hemolytic streptococci, such as an antistaphylococcal penicillin or a cephalosporin². Antibiotic for prophylaxis should be a single dose and should cover the common pathogens.

Even though it has been rationalized clearly, these are only guidelines. Considering the morbidity and mortality, weighing the benefit and risk and taking decision by the physician for individual patient is not irrational, where there is no clear cut data to support or refute the time honored standard of care.

**B: Surgical therapy**

There are no prospective randomized controlled trial data are available, hence the recommendations are based on the expert consensus opinion only. Early surgical interventions positively modify the disease course and reduce the morbidity & mortality rate.

**Definite indications for surgery include**

1. Moderate to severe CHF
2. Unstable prosthesis, obstructed prosthesis orifice.
3. Uncontrolled infection despite optimum antimicrobial therapy
4. Unavailable effective antimicrobial therapy.
5. Replase of PVE after optimal therapy
6. Fistula to pericardial sac.
Table 4: Primary Reasons for Revision of the IE Prophylaxis Guidelines

<table>
<thead>
<tr>
<th>Reason</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>IE is much more common from bacteremia associated with daily activities than bacteremia a dental, GI tract, or GU tract procedure. Association between various procedure induced bacteremia with endocarditis is not established. Extremely small number of cases of IE only be prevented by antibiotic prophylaxis even if 100% effective. The risk of resistance among the organisms increasing because of prophylactic antibiotic therapy. Maintenance of optimal oral health and hygiene may reduce the incidence of bacteremia from daily activities and is more important than prophylactic antibiotics for a dental procedure to reduce the risk of IE.</td>
</tr>
</tbody>
</table>

**SUMMARY**

1. Over the past 5 decades neither the incidence nor the mortality of IE has declined.
2. Novel risk factors and empirical antibiotics have increased the incidence of BCNE because of infection by a typical organism.
3. These atypical organism needs novel diagnostic methods like serology, molecular diagnosis, proteomics for diagnosis.
4. Duke’s criteria have been modified because of high BCNE. Serology has been included as the major criterion.
5. TEE should be considered as first step rather than TTE for prosthetic and pulmonic valve endocarditis.
6. StThomas modifications may be good adjunct for diagnosis of IE in Indian set up.
7. Surgery should be considered early in case of hemodynamic instability.
8. AHA /ACC released a restricted guidelines for IE prophylaxis, stating that good oral hygiene will reduce maximum number of IE cases.

**FUTURE PERSPECTIVE**

Developments and promising results on diagnostics from PCR will make it as essential part of IE workup may become included into Duke’s criteria soon. In the future molecular techniques like DNA probes and microarray technology, Spectroscopic fingerprinting, proteomic may provide diagnosis with in 24hrs. Not only may the organism resistance gene also be identified with these novel interventions. Currently newer vaccines targeting the specific bacterial adhesions are emerging; they inhibit colonization of organisms.

- Newer Antimicrobial agents, to combat S.Aureas & Entero cocci are on the anvil.
- Modified bio material used in artificial valves & intra cardiac prosthesis may reduce the risk of IE.

**REFERENCES**

9. Excellent and comprehensive review of specific serological tests to aid in the diagnosis of blood culture-negative endocarditis.