Incidence of Infective Endocarditis Due to Dental Caries

R.Priyanka

CRI
BDS Saveetha Dental College.
Chennai-77

Abstract: The most unaware cause of Infective endocarditis is Dental Caries. IE is a serious infection of the heart valves. The bloodstream is sterile under a normal healthy condition. Introduction of bacteria into blood stream leads to intracardiac infection. The main causative organisms include the Streptococcus viridans, Staphylococcus aureus, Coagulase negative streptococci. This disease occurs mainly in damaged valve patient, immunosuppressive patients as these patient's immune cannot battle against the invaded microbial agent. There occurs blockade in the valve due to the bacterial vegetation formation caused by the platelets and fibrin material. It is common sign and symptom would be fever, anemia, Roth's spots, Osler's sign. The dental caries is also a microbial infection which remains to be one of the main cause for IE. The microbial attack causing the dissolution of the hard tissues of the teeth penetrates to the deeper structures of the teeth and thus causing the bacterial invasion into the blood stream.

Introduction:

Infective endocarditis is an infection in the endocardium of the heart valves caused by infectious pathogens like bacteria. The valves of the heart do not receive the targeted blood supply thus leading to reduction in the immune response that is supplied via the blood stream. The lack of supply of blood to the heart rely to be an implication for the treatment, as drugs also have the difficulty in reaching the areainfected. It is a serious infection that remains to be fatal if untreated.

The most unaware incidence of IE is due to Dental Caries.Caries are caused mainly when the sugar in food or drink gets in contact with thebacteria present in the dental biofilm like plaque and calculus on the tooth surface resulting in acid production. The acid that is produced lead to demineralization.

Occurrence of IE:

IE occurs only by infection caused by bacteria or fungi. These species cause infection via the blood stream. But the blood stream does not have the infectious pathogens, these pathogens enter the blood stream via

1. Oral infections like plaque, Dental caries etc.
2. Street drug injectors injecting with contaminated and dirty needles
3. Infections
4. Wounds
5. Congenital heart defects.
6. Already damaged heart valves
7. Hypertrophic cardiomyopathy
8. Poor immune system, example : people with AIDS

Progression of IE:

The immune system normally destroys the invaded bacteria and fungi, but still some bacteria persists in the blood stream and settles in the heart valve or any other part of the endocardium causing infection, at time which the immune system finds it difficult to destroy the bacterial infection. At times small clumps called vegetation develop containing bacteria, fungi, small blood clots, debris. These vegetation may break into fragments and circulate in the bloodstream to other body parts.

Signs and Symptoms:

The common mnemonic for signs and symptoms of IE is ' FROM JANE ' :

- Fever
- Roth's spots are retinal hemorrhages with white or pale centers.
- Osler's sign which is the painful subcutaneous lesion in the distal fingers.
- Murmur which is a new or changing murmur.
- Janeway lesion, painless hemorrhagic cutaneous lesions on palms and soles.
- Anemia
- Nail hemorrhage
- Emboli – Causing thromboembolic problems like stroke in the parietal lobe of brain or gangrene of fingers.

Symptoms develop very slowly in some cases which is known as the sub-acute bacterial endocarditis. Fever is pronounced in about 97% of the people and fatigue in 90% of patients. Heart murmurs develop in these patients as a result of abnormal blood

flow to the valves is seen in about 35% of the people with weight loss and cough. A new or changing murmur is felt which alerts the doctor to suspect this condition. Symptoms develop over weeks or months. These are slowly developing infection. In certain other cases the symptoms occur very rapidly causing high fever within a very few days. The speed of the symptoms depend on which the bacterium or fungus is involved.

Other signs and symptoms include Glomerulonephritis which allows for blood and albumin to enter the urine, renal hemorrhages and infarct, splenic infarcts, intracranial hemorrhage, conjunctival hemorrhage, malaise, rigors, night sweats, splenomegaly.

Causes:

Many microorganisms are involved in causing Infective endocarditis. The microorganism involved in the disease is identified by culturing the blood sample collected from the patient.The three bacterial organism mainly involved in causing the disease are Staphylococcus aureus, Streptococcus viridans and Coagulase negative streptococci. Other streptococci and enterococci are also frequent cause of infective endocarditis.

- Enterococcus enters the bloodstream as GIT infection.
- Viridans alpha- Hemolytic streptococci present in the mouth is one of the most frequently isolated organism that is acquired in a community.
- Staphyllococcus infection are frequently acquired when there is break in the continuity of the skin like surgery, catheterization or while access of long term indwelling catheters or secondary to intravenous injection of recreational drugs.
- Pseudomonas species that live in water cause contamination of street drugs that have been contaminated with drinking water and pseudomonas aeruginosa infects children through foot punctures causing septic arthritis and IE.
- Streptococcus bovis and Clostridium septicum, when present as the causative organism results in colonoscopy immediately due to its hematogenous spread of bacteria due to the neoplasm braking down the barrier between the gut lumen and the blood vessels that drain through the bowel as these are the common flora of the bowel.
- HACEK are a group of organism that live on the gums due to poor oral hygiene, pre-existing valvular diseases and can be seen with IV drug users who contaminate their needles with saliva.
- There are a few less commonly occurring species which are responsible for so called ‘culture negative endocarditis’. These include Bartonella, Chlamydia psittaci and Coxiella.
- Other unusual organisms that cause this are Propionibacterium sp., Tropheryma whipplei, Citrobacter koseri, Neisseria bacilliformis etc.
- Candida albicans a yeast is associated with endocarditid was noticed in IV drug users and immunocompromised patients.
- Other fungi species like Histoplasma capsulatum, aspergillus, Tricosporon asahii have been reported.

Risk factors:

1. Artificial heart valves.
2. Intracardiac devices.
3. Untreated congenital heart defects.
4. Chronic rheumatic heart disease.
5. Age related factors.
6. Hemodialysis
7. Immunosuppressive diseases like Diabetes mellitus, alcohol abuse, HIV/AIDS.
8. Colorectal malignancy.
9. Urinarytract infection.
10. Drug injection
11. Virulent organism entering the blood stream can affect the healthy heart.
12. Dental caries.
13. Post extraction complication.

Diagnoses:

The investigation is best seen in Echocardiography. The diagnosis is complete only if it satisfies Duke criteria. Duke criteria rely on echocardiographic results. The diagnosis is definite if either the pathological or clinical criteria are present.

Modified Duke Criteria:

- One of the Pathological criteria: Histologic or culture of
    1. Cardiac vegetation
    2. Embolized vegetation
    3. Intra cardiac abcess.
    4. Active endocarditis.
- Clinical criteria:
    1. Major criteria

2. Minor criteria

- Major criteria:
  - ✓ Positive blood culture involving the exact microorganisms in two separate blood cultures:
    1. Viridans group streptococci or
    2. Streptococcus bovis or
    3. HACEK group or
    4. Staphyllococcus aureus or
    5. Community acquired Enterococci, in absence of primary focus
  - ✓ Positive organism in persistent positive blood culture
    1. Two blood samples showing positive cultures drawn >12 hours apart or
    2. 3 or 4 samples collected and cultures separately, (exactly the first and the last sample collected one hour apart).
    3. Coxiella burnetti detected by one positive blood culture or IgG antibody for Q fever phase 1 antigen>1:800.
  - ✓ Evidence of endocardial involvement with positive echocardiogram defined as
    1. Oscillating intracardiac mass on valve or supporting structures, in the path of regurgitant jets. Or on implanted material in the absence of an alternative anatomic explanation, or
    2. Abcess or
    3. New partial dehiscence of prosthetic valve or new valvular regurgitation

- Minor criteria:
  1. Fever >38'C
  2. Immunological problems – Glomerulonephritis, Osler's nodes, Roth's spots, Rheumatoid factor.
  3. Embolism
  4. Cardiac lesion, recreational drug injection.
  5. Positive blood culture or serologic evidence of infection with organism consistent with IE but not satisfying major criterion.

Diagnosis of Infective Endocarditis becomes positive if the following combinations of the criterion are met:

- 1 major and 1 minor criteria.
- 3 minor criteria are fulfilled.

Dental Caries and Infective Endocarditis:

Dental caries is an irreversible microbial disease of the calcified tissues of the teeth, characterized by the demineralization of the inorganic portion and destruction of the organic substance of the tooth, which often leads to cavitation. This type of bacterial infection that occur in the oral cavity, might cause the bacteria that is present to enter the blood stream which is sterile. The bacteria first dissolves the hard tissue of the teeth and then reaches the soft tissue if left untreated. This infection on reaching the pulp traverse beyond the apex of the tooth resulting apical periodontitis and widening of the periodontal ligament space. As the microbial agent passes through the deeper tissues it enters the blood stream thus infecting the blood.

The main cause contributing to IE is damaged valves, forming a blood clot known as Non-Bacterial Thrombotic Endocarditis. The platelets and the fibrin that help in the formation of the clot also encourages the bacteria that has invaded the bloodstream to form a vegetation.

As mentioned earlier as the infection goes deeper and deeper into the soft tissues of the teeth, leading to bacterial invasion in the blood, in the damaged valves forms blood clot leading to bacterial vegetation formation resulting in Infective Endocarditis. This is caused mainly in people with combination of damaged valves, bacterial growth and immunosuppressive patients.

Treatment:

High dose of antibiotics administered IV as the antibiotic molecules diffuse into the vegetation from the blood filling the chambers of the heart. In acute endocarditis immediate antibiotic therapy of Vancomycin and Ceftriaxone IV infusion. In subacute endocarditis, the patient remains in a hemodynamic status, so the antibiotic therapy can be delayed to the patient until the causative microorganism can be identified.

The causative organism Staphyllococcus aureus is Penicillin resistant and sometimes Oxacillin resistance, in which cases are treated with Vancomycin.

Viridans group of Streptococci and streptococcus bovis are treated with Penicillin or Ceftriaxone. Resistant strains of viridans group streptococci and Streptococcus bovis are treated with Penicillin or Ceftriaxone along with aminoglycoside during the initial phase of treatment.

Certain patients are treated with a shorter course of treatment with benzyl penicillin IV. The routine use of Gentamicin is totally reduced because of its higher rates of complication.

Conclusion:

Dental caries is the most common oral hygiene problem in 60 - 90% of the school children and majority of the adults. The presence of bacteria in the oral cavity mostly triggers the bacteria to circulate into the blood leading to infection. There are common flora of the oral cavity that are always present in the oral cavity that are harmless. The acid formation activity of the bacteria leads to the caries formation in the teeth. If unnoticed or untreated this may lead to any complication causing apical periodontitis, and further travel of the bacteria results in life threatening complications if the patient has a valve damage or immunosuppressive.

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