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Microbiology in endodontic infections

As we know, we need bacteria to have endodontic disease. So,

NO BACTERIA NO ENDODONTIC DISEASE.

An experiment was done by Takahashi, he did a surgical exposure in two groups of rat; conditional exposure in one group and septic exposure in the other, and he found that we need bacteria to have an endodontic disease.

We said last time that we should follow ABC formula to get success in root canal treatment, but what if we follow this formula and perform all steps properly and failure happened?! Based on microbiological studies; post treatment failure and post treatment apical periodontitis can be regarded as a microbiology problem “caused by bacteria”.

Apical periodontitis: disease caused by bacterial infection in root canal.

The primary problem in endodontic therapy is infection, so the cleaning and shaping without disinfection is useless.

Rct is mechanical and chemical process to: “biological objectives”

- eliminate infection

- prevent reinfection and

- achieving biological or microbial seal. So our end target is microbial seal.

Biological objectives are achieved by :

1- Complex cleaning and shaping and disinfecting root canal to eliminate infection.

2- Complete optimal obturation of root canal in 3D to prevent re-infection

3-Obtain coronal seal following root canal treatment to prevent re-infection

But unfortunately, there are no modalities available at all, to guide us how to obtain these biological objectives.

Infection: is the ability of organism to survive in a host for short period of time.

 If the organism can increase in number or can produce sufficient contents of toxic substance that affect the host in an abnormal way, then it can cause disease.

Around 7 hundreds species of bacteria are coexisting in adult mouth! Any of these bacteria can turn up into root canal to cause inflammation and infection.

“If you want root canal treatment to fail; spit in the canal”

The dr said this sentence just to emphasis the importance of good disinfection and the importance of good isolation, because saliva means bacteria.

In root canal, we are dealing with a very dynamic environment, so endodontic treatment is more than just a dental procedure!

Bacterial distribution in canals:

-The pattern in each tooth is unique.

- Abundance of bacteria is generally greater apically than coronally, and the middle part tends to have less bacteria.

The enemy zone: is the zone of infection or the zone of necrosis which contains the bacteria, the abundance of bacteria is generally greater apically than coronally, and the middle part tends to have less bacteria.

So, we start with less bacteria in the coronal part and end up with more bacteria in the apical part, and this concept is part of something called “the history of dynamic in endodontic infection” and we will talk about it later.

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| --- | --- |
| Coronally | More actinobacteria |
| Apically | More taxa and diversityMore obligate anaerobesMore proteobacteria |

Note:

- Not all dentinal tubules around the canal will invade by bacteria, because the infection tends to be localized within the canal (simply, because the nutrition in the tooth is localized within the pulp and root canal system).

-BUT only if cementum is eroded, bacteria tend to penetrate all the way through; the whole thickness of root canal in this case could be invaded by bacteria, and this is the case of chronic apical periodontitis where there is resorption in the tooth surface in the apical area.

- In previously filled tooth, this DEPENFING ON the quality and length of filling.

Biologically, all periapically affected teeth contain bacteria, which mean that: the condition of root canal is a guide to the condition of periapical tissue; that’s mean when bacteria are present lesion and infection is present in the apical portion of root canal system. When the lesion is large the diversity of infection is much greater. And this will affect the outcomes of treatment.

As we know, apical periodontitis( the disease that caused by bacterial infection in root canal system) is the ultimate disease to all dentist and specially for the endodontist, bacteria will produce substances and induce immune response, this immune response will mobilize molecular antibodies and phagocytes in the root canal, these antibodies and phagocytes will accumulate in areas near to place where bacteria exit to prevent bacteria from gaining access to the bone and avoid osteomyelitis and systemic effect. These immune responses have a double sword; they will benefit the tooth but on the other side they will cause a damage (some of these mediators are strongly activating the osteoclasts in the area and cause destruction of the bone and connective tissue in the area).

This could be helpful (from last year sheet)

Bacteria

Release substances

Induce immune response

1- Induce of destruction of canal tissue

2- induce clinical signs and symptoms

3- lead to environmental changes that provide nature for **bacteria**

Mediators

Mobile molecular phagocytes

Prevent bacteria to gain access to bone & avoid osteomylitis and systemic effects

When pt presents with acute clinical signs and symptoms (pyrexia, trismus, facial swelling, etc) that indicate active disease or productive lesion, and in this case antibiotics are indicted, because the office for national statistics 200-2005 reported that between 8-16 pt died per year due to dento-alveolar abscess! So, if the pt shows acute or sever clinical signs and symptoms of disease should be covered by antibiotics.

We all know the focal infection theory, this theory creates a climent of bacteriophobia in medicine and dentistry.

Now the question is, does the periapical lesion serve as focal of infection and lead to death? Does secondary disease from oral focal occur?

Bill Henderson tries to find the link between the root canal disease and cancer! The result was 70%-80% of the cancer victims had an endodontic lesion or present with signs and symptoms of disease with environmental changes and inflammatory exudate. (This is totally wrong)

Note:

Inflammatory exudate rich in proteins and glycoproteins and this will provide nutrition to the bacteria in the apical part of the canal.

Some studies shown that genetic and systemic conditions, as well as acquired habits also could stimulate this procedure and affect the apical periodontitis. What happens beyond the apical foramen remains subject to debate.

As a conclusion, spread of infection is possible if treatment is delayed or if treatment is performed unsuccessfully. Even in case of infection and lesion, the life expectancy for the tooth is fairly good, but

 –if you want the tooth to die  leave it or extract it.

 –if you want the tooth to live  do prober RCT

Teeth don’t die in a natural death we usually kill them!

Bacteria are said to have been in the existence for more than 2 billion years, able to colonize, divide and hash in the earth.

Bacteria that living in the root canal are fortunate, because the blood supply from the pulp canal space will provided to bacteria then they can escape to enjoy their life away from body defense mechanisms, also the bacteria in root canal will provided by an excellent culture media (because they are in an environment ideally serve as incubator regarding temperature and humidity etc..)

The first scientific report about the diversity of microbiota was published as early as 1894 by Miller who observed the presence of bacteria in an inflamed pulp.

Until the mid of seventy, the dominant concept was that anaerobes are not significant in endodontic periapical disease, because they believe that anaerobes are easily destroyed by when come in contact with oxygen after access cavity preparation or using various irrigating solution that contain an oxygen.

Now, Sundqvist did a study in the endodontic literature regarding the diversity of microbiota, he was trying to gain as strict as possible to anaerobic condition, after that around 10-12 studies used the same culture an technique and that lead to expansion in the diversity of endodontic microbiota.

Endodontic infection differ from infection elsewhere in the body in something important, it is not cause by one specific microorganism.

Actually, root canal infection caused by mixture of facultative anaerobes gram positive strains dominating by obligate anaerobes.

Using culture techniques we can identified up to 12 bacterial strains, by using more sophisticated molecular techniques we can cultivate up to 40 strains, while the actual estimated number of species inside the root canal is 90(close to that in perio disease). Also we can find fungi and viruses in case of failure.

**“If you file, don’t close. And if you close, don’t file”**

This rule was destroyed. As a conclusion, teeth should be kept close throughout the treatment, otherwise complications like re-closure and flair up could happen.

After 5 generations studies in endodontic microbiology, we believe that apical periodontitis is a biofilm induced disease.

We can find the bacteria in the canal suspended, and they called planktonic bacteria (bacteria in free form). In term of treatment they are not significant because instrumentation and irrigation have a direct access to planktonic bacteria.

Again, free form bacteria can physically blocked by the irrigant.

 The most important are the bacteria that adhere to the canal walls forming sessile state and they called biofilms.

At least 65% of all bacterial infections have biofilms as integral part of their pathogenesis.

In acute situation we can find a thick layer of biofilm inside the root canal system.

Inside the biofilm, bacteria act as single large multicellular organism that has a great intelligence; it is not an inert structure that can simply kill. So, there are a different between bacteria in the biofilm and bacteria in free form.

Endodontic biofilm categories:

-Intracanal biofilm

-Extracanal biofilm (calcified mass on the root surface), they are responsible for delayed healing after treatment.

-periapical biofilm (isolated in the periapical region)

-Foreign body centered biofilm: (aggregation of actinomyces cells)

And this foreign body centered biofilm is a major complication associated with prosthesis and also in an implant supported prosthesis. And it related to periapical disease in endodontics.

In 2010, a study was done in hundreds of biopsy specimens to look for biofilms in the apical part of root canal in the cases of periapical periodontitis, the presence of biofilms was found to be 77%, which mean that all infected root canals contains bacteria, in 77% of cases they produce biofilm in the apical part of root canal. Specifically:

80% in untreated teeth

74% in treated teeth

Conclusion;

The large majority of teeth we are dealing with biofilms. And in the apical periodontitis we have a great chance to deal with biofilm in the apical part of the canal.

The prevalence of biofilms is larger in cysts and large lesions:

69.5% in granulomas

95% in cysts

85% in abscesses

And these have lower success rate because the cause of large lesion is more complex and very difficult to eradicate.

In 6% of cases we can find extraradicular biofilms, it is impossible to remove ( it is look like calculus in perio need scaling).

 Extrardicular biofilms can present even after successful eradication of intraradicular biofilms.

Combinations of oral bacteria are able to survive better than single species.by synergism 1+1=more than 2. Bacteria in the biofilm will produce virulent soup and cause direct and indirect damage to the host.

Biofilms Is a challenge to chemomechanical preparation because the matrix of biofilm (structural dense organization of the biofilm within the polymeric matrix restrict the penetration of any agent into biofilm (resist amoxicillin, doxycycline, metronidazole), hey are more one thousand times more resistant to phagocytosis and antibody than non-biofilm producing bacteria.

Mechanical removal by instruments is only effective in some areas on the root, what we need is dissolution by sodium hypochlorite and detachment by ultrasonic energy.

 Biofilm need a surface to hang on, so we need agitation to move the debris and detached biofilm and its break up matrix in the solution, then eliminated from endodontic space.

 Best method to deal with biofilm is scraping. So they try to replace the instrument that based on rotation, and create instrument work in bucco-lingual direction to scrape the biofilm from root surface. Also, Instead of traditional approaches with single active component irrigant(smear irrigant), we need an organized multiple attack strategies and multi agent approach that will attack different aspect of bacterial cell membrane.

THE LECTURE WAS VERY CONFUSING AND I DID MY BEST TO MAKE IT UNDERSTANDABLE, SORRY FOR ANY MISTAKE.

GOODLUCK ☺