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A Review Article on Staphylococcus Haemolyticus

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Abstract:
Staphylococcus haemolyticus is a newly-associated OPP which is a major concern to the immunocompromised patients. The key points from the search results are: The key points from the search results are: Thus, S. haemolyticus can attach and penetrate the primary human skin fibroblast cells with an emerge in cytotoxicity and additional level of apoptosis. It possesses seem to encode factors of virulence that cause enterotoxins and alpha-hemolysin. S. haemolyticus is the second, or third if S. epidermidis is considered, among the coagulase-negative Staphylococcus most frequently isolated from clinical samples, being an agent of hematogenous and device-associated infections. It has a high propensity to cause resistance to antimicrobials particularly glycopeptides though treatment options are limited. S. haemolyticus Clinical strains of the S. haemolyticus are more virulent than skin originated isolates, more prone to form biofilms, and at least to Oxacillin and Aminoglycoside. S. haemolyticus is one of the significant pathogens of neonates, which affects primarily in the late onset sepsis, and has increased prevalence of multidrug-resistant strains in certain places.

Introduction:

Staphylococcus haemolyticus is a CoNS isolated from the human skin and is usually regarded as an opportunistic pathogen. It is the second most common CoNS identified in clinical specimens especially in blood cultures of septicaemia patients second to S. epidermidis. S. haemolyticus is an invasive, facultatively anaerobic bacterium that may infect several systems, such as the central nervous system, heart valves and prosthetic devices, joints, blood, peritoneum, ear, and diabetics' foot ulcers. Another factor that has attributed to S. haemolyticus becoming one of the important pathogens today is its resistance to antibiotics. Different strains come as MRS: methicillin, oxacillin, gentamicin, erythromycin, clindamycin, tetracycline, ciprofloxacin. Both, the status of being a multi-drug resistant organism coupled with the organism's predisposition to biofilm formation make S. haemolyticus a tough pathogen to deal with. S. haemolyticus strain JCSC1435 harbours a single 2,685,015 bp Chr and three plasmids, belonging to IncP-1 group. With respect to the genomes of S. aureus and S. epidermidis, comparative analysis showed that the majority of open reading frames (ORFs) are identical between all three species and positive Igs indicate that orthologous ORFs share 78% of identity on average. Nevertheless, S. haemolyticus does possess sequences in its chromosomes located around oriC which is termed as the oriC environ. These regions are higher on species-specific nonessential genes that define the S. haemolyticus organisms' biological attributes.

The primary virulence factors of Staphylococcus haemolyticus are: The primary virulence factors of Staphylococcus haemolyticus are: Biofilm formation: S. haemolyticus has high capacity to adhere to PE and other medical devices, when it forms biofilm, it is resistant to many antibiotics making the infections chronic. It is understood that biofilm development is dependent on the extracellular DNA, proteins, and carbohydrate. Antibiotic resistance: S. haemolyticus is accountable for the highest level of antibiotic resistance among all the CoNS, which complicates treatment of the infections. In many cases, resistance genes are situated in the specific portions of the genome of S. haemolyticus. Adhesion and invasion: S. haemolyticus can also infect primary human skin fibroblast cells where it attaches itself to the cells and induces intensive cell death as well as activates programmed cell death. It is anchored by the

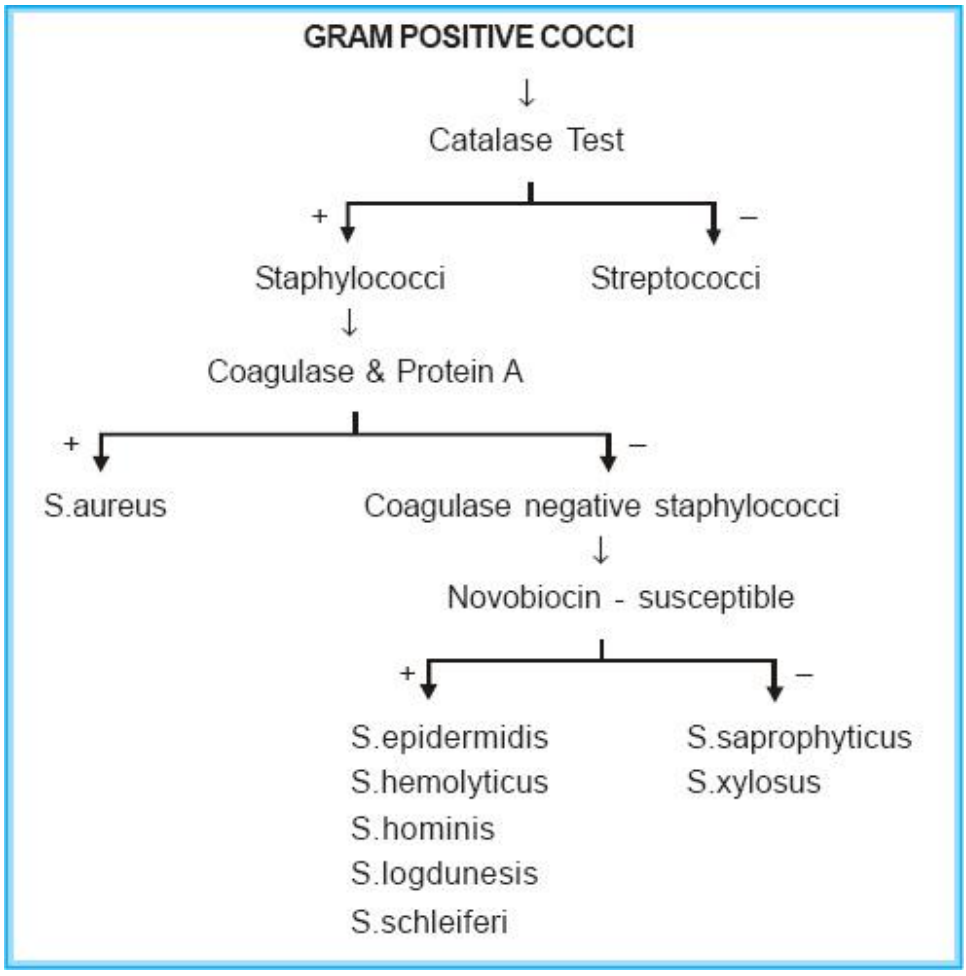
surface adhesins genes belonging to the species particularity of chromosomal location. Toxin production: S. haemolyticus also secretes enterotoxins and haemolysis which are associated with food poisoning, toxic shock syndrome and tissue injury. Among the enterotoxin genes, the commonest are seg, sea, and sec. Therefore, due to the biofilm formation, antibiotic resistance, adhesion/invasion factors, and toxigenic properties, S. haemolyticus is considered an important opportunistic pathogen mainly associated with immunocompromised, medical implanted patients.

Classification:

Staphylococcus haemolyticus belongs to the CoNS and is a part of the skin microbiota of humans. Its classification is as follows: Its classification is as follows:

Domain: Bacteria
Phylum: Bacillota
Class: Bacilli
Order: Bacillales
Family: Staphylococcaceae
Genus: Staphylococcus
Species: S. haemolyticus

S. haemolyticus is the second most common CoNS isolated from human blood cultures, next to S. epidermidis. As it is subjective to become a part of different pathological processes, they are classified as opportunistic pathogens that can result in localized or systemic infections related to the usage of medical instruments. Its resistance to antibiotics is extremely high; therefore, S. haemolyticus is considered to be a rather recalcitrant pathogen.



Morphology:

Staphylococcus haemolyticus is a Gram positive, cocci form bacteria commonly isolated from human skin and animal rates. Some key features of its morphology include: Some key features of its morphology include: Gram-positive: S. haemolyticus can be stained with the Gram-positive reagents since it has a thick layer of peptidoglycan layer in its cell wall. Coccus-shaped: In this, the cells are not rod- shaped, but are, instead, round shaped. Aerobic: S. haemolyticus is an aerobic organism – oppose; this means it needs oxygen for support and growth. Catalase-positive: It secretes an enzyme, catalase, to enable the bacteria to decompose compounds of peroxide of hydrogen. Coagulase-negative: Worthy of note, S. haemolyticus is not pathogenic like the Staphylococcus aureus which differentiates it from the later based on the fact that it lacks coagulase. Haemolytic: S. haemolyticus is known to result to CNL or the lysis of the red blood cells to an extent.

Adaptation:

S. haemolyticus, therefore, has blossomed into an opportunity-seeking pathogen in most infections prevalent in hospital settings. Antibiotic resistance: S. haemolyticus clinical isolates are more resistant to multiple antibiotics and 88% of such isolates are usually resistant while 11% are commensal isolates. This could be attributed by more use of the antibiotics which in turn give rise to resistant genetically possessed and adaptative clone types within the hospital setting. Biofilm formation: However, S. haemolyticus is capable of forming biofilms, the antibiotic resistance is not only high, but also easy to develop chronic infections. There are several factors which affect the synthesis of the biofilm and these include the extracellular DNA, glucose and NaCl. Virulence factors: S. haemolyticus successively forms different subgroups and produces enterotoxins and haemolysis, which are of value in understanding the manifestation of the disease. Clinical isolates also have a SraP of serine-rich repeat glycoprotein and the new capsule polysaccharide operons, which can become involved in virulence. Genomic adaptations: It contains many insertion sequences in its genome may be as it can reach recombination in different stresses including antibiotics. Therefore, S. haemolyticus carries the potentiality to be a potent opportunistic pathogen that can pose threat in hospitals and possess the capacity to develop resistance to antibiotics, formation of biofilms, virulence and genes which can achieve the constantly changing antimicrobial strategies.

Mode of transmission:

Staphylococcus haemolyticus the most common mode of transmission is through direct contact or indirect contact with contaminated objects. undefined

S. haemolyticus is a part of the normal flora on human skin and it has the potential to be transmitted from one person to another directly or indirectly through fomites.

S. haemolyticus can present itself as a local or systemic pathogen, with most infections linked to the use of medical prostheses. It has a potential to form biofilm hence contributing to increased antibiotic resistance and recurrent infections.

S. haemolyticus is an opportunistic pathogen and ranks the second among the coagulase-negative Staphylococcus species following S. epidermidis. It has been progressively associated with hospital-acquired infections.

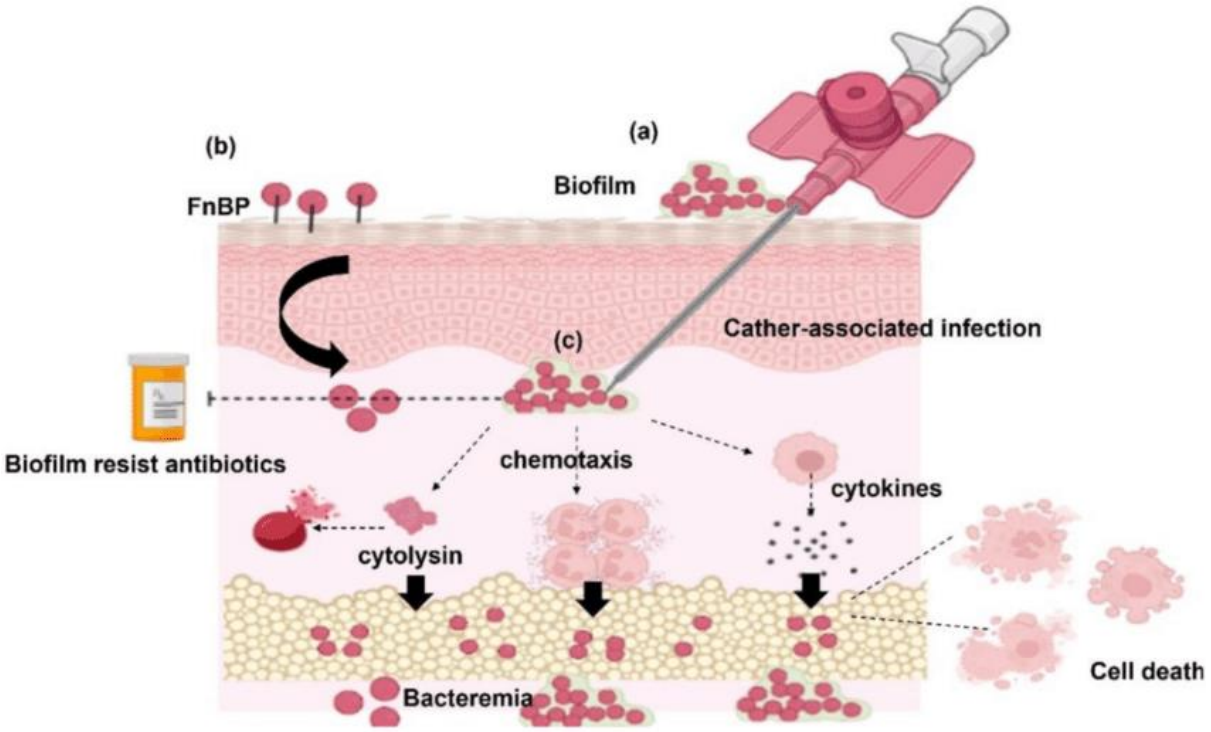
S. haemolyticus also infects primates and domestic animals and, thus, can be a source of infection.

In conclusion, the major route of transmission of S. haemolyticus is direct contact with infected persons or objects, resulting in localized or systemic infection primarily in clinics.

Pathogenicity:

Bacteraemia/sepsis: S. haemolyticus is an invasive bacterium that can lead to bloodstream infection and presents the range of symptoms that include fever, chills, hypotension, organ dysfunction, and others. Endocarditis: The signs and symptoms of the infective endocarditis include fever, new or changing heart murmurs, and clinical signs of heart failure. Prosthetic device infections: Friedman describes that infection that occurs due to medical implantation like catheters or joint replacements only leads to localized pain and inflammation in the regional tissues. Skin/soft tissue infections: It may lead to abscesses in the skin,

cellulitis, or wound infection with clinical presentations like pain, swelling, redness, and discharge of pus. Diabetic foot ulcers: S. haemolyticus can infect foot ulcers in diabetic patients and results in increased pain, inflammation and slower rate of healing of ulcers. In most cases, the symptoms of the disease get worse if the patient has other illnesses or a compromised immune response. S. haemolyticus has been identified to be highly resistant to antibiotics which are often employed to treat such infections.



Mechanism:

Staphylococcus haemolyticus is an opportunistic pathogen, although it can cause infection in immunosuppressed individuals. The key points about the pathogenesis of S. haemolyticus are: The main facts about the pathogenesis of S. haemolyticus are: S. haemolyticus possesses hundreds of virulence factors including fnbA and fnbB that enable the bacteria to adhere to host tissues. S. haemolyticus can also be internalized into the primary human skin fibroblast (PHSF) cells in zipper like motion. These changes lead to significant decrease of PHSF cell proliferation rate and increase in apoptosis. S. haemolyticus has been found to elicit higher levels of pro-inflammatory cytokines when co-cultured with human PBMCs. S. haemolyticus strains appear to be capable of targeting mitochondria in macrophages and simultaneously results in the loss of MMP and stimulation of caspase-dependent apoptotic death of host cells. This makes it possible for the bacteria to evade the immune response mechanism of the host. S. haemolyticus can also develop resistance to the antibiotics such as linezolid through mutation in the 23S rRNA gene or through the acquisition of genes like cfr.

Risk factors:

Staphylococcus haemolyticus is an opportunistic pathogen and has potential to cause sever pathological conditions especially in immunocompromised patient and patients having implant or device. Undefined
Diabetes mellitus: Diabetic patients are predisposed to bacterial infections, S. haemolyticus being common in case of foot ulcers in diabetic patients. Immunocompromised state: S. haemolyticus is known to cause more severe infections in immunocompromised patients including cancer, organ transplant, and AIDS. Presence of medical devices: S. haemolyticus can act as a pathogen using indwelling medical devices like catheters, prosthetic joints, and central lines as a supportive structure. Hospitalization: S. haemolyticus is often found in clinical settings and its transmission may occur through the hands of healthcare personnel to patients in hospitalized settings. Neonatal age: S. haemolyticus is a leading pathogen in late onset sepsis in neonates with majority from intensive care units.

Diseases caused:
Staphylococcus haemolyticus is an invasive organism that has been reported to cause infections in immunocompromised patients and in those with implantable medical devices. It is the second most frequently isolated CoNS in clinical settings, more so in cases of blood-related infections such as bacteraemia. S. haemolyticus is commonly associated with implant-associated infections and has a considerable ability to produce biofilms, which enhance both antibiotic resistance and subsequent infection. Also, some of the strains contain enterotoxin and haemolysin and this increases its pathogenicity index. S. haemolyticus has a higher clinical significance because of the potential of the pathogen to become resistant to all the drugs including the glycopeptides. This could help it acquire antibiotic resistance due to every high number of insertion sequences and the identified SNPs point to its genome flexibility.

Prevention:
Ensure proper hand washing by washing your hands with water and soap or using hand-sanitizer regularly after touching the infected parts.
Do not share personal effects like towels, razors, clothing, and beds as this lead to buildup of bacteria. For soiled clothes, one should wash them well by using water and soap. It is important not to expose wounds to contaminants and always protect them until they have healed completely. In the event you get infected, clean the affected area and then bandage the area to avoid the spread of the bacteria to other parts of the body or to other individuals. Keep nails clean and short, avoid using a loofah while bathing or showering, and wear fresh underclothes, pyjamas, towels, and washcloth daily. Carry out environmental hygiene using high risk contact objects and employing commercially available biocides. Normal washing and rinsing practices in accordance with directions on detergent packaging are typically adequate to sanitize items. Minimize contact with individuals harbouring the infection so as to minimize chances of spreading the disease. When in a clinic go for a wash with soap and warm water if you are leaving the room or have been to the bathroom. Adopting these measures can go a long way in preventing Staphylococcus haemolyticus infections especially since the said bacteria can be especially dangerous in places such as hospitals and to immunocompromised persons.

Public health importance:
Based on the search results, the following treatments are available for Staphylococcus haemolyticus infections: The available treatments for Staphylococcus haemolyticus infections based on the search results include: Bacteriocin-based treatments: Enhancement of antimicrobial efficiency of newly identified H1 hybrid bacteriocin against S. haemolyticus strains: clinical and commensal isolates. H1 interacts with the membrane-bound protease RseP like the original enterocin K1 and enterocin EJ97. Combination bacteriocin therapy: From my study it was evident that combination of H1 with the broad spectrum bacteriocins of micrococci P1 and garvicin KS proved to be drastically effective against both the planktonic and biofilm associated S. haemolyticus cells and also help in restricting the appearance of the resistant mutants.
Antibiotic therapy: As such, S. haemolyticus has been described as being biochemically resistant to a number of antibiotics including Vancomycin. Some other antibiotics including daptomycin and linezolid possess similar in vitro activities against S. haemolyticus but are contraindicated in CNS infections.
Addressing the source of infection: As well as the antimicrobial therapy, one should consider the source of S. haemolyticus infection that can be the infected catheters, prosthetic implants, and so on. The general findings of the first part of the search indicate that bacteriocin based therapies could be most effective in form of combinations in controlling MDR S. haemolyticus related infections; conventional antibiotics remain limited by the organism's resistance pattern.

Economic impact:
Biofilm formation enables S. haemolyticus to colonized medical devices such as catheters or prosthetic implants leading to persistent and difficult-to-eradicate biofilm-related infections that may necessitate

removal of the device. These structures protect bacteria from the host-immune system and antibiotics, thus making infection more difficult to manage. S. haemolyticus is inherently resistant to multiple drugs, making it difficult to treat biofilm-associated infections. In one research, S. haemolyticus strains are quickly becoming an especially dangerous nosocomial pathogen because of the biofilm-forming capability, persistence, and adaptation to the hospital environment. Although specific details on economic loss of S. haemolyticus are yet to be determined, related studies focus on the costs associated with Staphylococcus aureus infections in hospitals. S. aureus infection leads to an approximate doubling of the length of stay, death rate, and costs per hospitalization. Namely, S. haemolysis's biofilm-forming ability enhances this bacteria's pathogenicity and the ability to cause challenging infection treatments, which more than likely increases health care costs through increased hospital stays, mortality, and costliness of treatment. Some of the costs that could be saved if biofilm formation was avoided included.

Conclusion:

Names of such devices include central venous catheters, prosthetic valves, orthopaedic prostheses, and urinary catheters. This organism is known to adhere to these devices and can potentially lead to severe infections. Previous antibiotics administration, they found out that it has a significant correlation with S. haemolyticus bloodstream infection. The rarity of soft-tissue infections and the fact that they mostly occur in immunocompromised individuals. Diabetes mellitus which causes immunocompromised status hence increased chances of bacterial infection such as S. haemolyticus in diabetic foot ulcers. Hospitalization for the management of other illnesses and complications because S. haemolyticus is an opportunistic nosocomial pathogen that is frequently isolated in hospitals. Invasion and colonization of the gastrointestinal tract that seem to be the primary source of S. haemolyticus in causing genitourinary infections such as epididymis-orchitis by moving up the digestive tract. To conclude, risk factors associated with invasive S. haemolyticus infections include foreign medical devices, immunocompromised conditions, diabetes mellitus, prior exposure to antibiotics, and hospitalization. It is essential to recognize the signs early enough and ensure the patient receives the right treatment if not cured completely.

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