



RESEARCH ARTICLE

CLINICAL RELEVANCE AND ROLE OF FUNGAL AND BACTERIAL INFECTIONS ON HUMANS

Lakshmi Prasanna Sanikommu¹, Monyya Sree Kommineni¹, Manasa Yerramreddy¹, Sai Venkata Lakshmi Lingam¹, Sri Harsha Kathi¹, Bharathi Yelem¹, Vasavi Radha Sajja¹ and Reethika Singh Ranwas²

1. Department of Biotechnology, Koneru Lakshmaiah Education Foundation, Guntur, Andhra Pradesh, India.
2. Department of Bioengineering and Technology, Technical Research Centre, North East Research Enclave Campus, Guwahati, Assam, India.

Manuscript Info

Manuscript History

Received: 10 May 2022

Final Accepted: 14 June 2022

Published: July 2022

Key words:-

Fungi, Bacteria, Infections, Clinical, Antibiotics, Pathogens

Abstract

The purpose of our study is to focus on the causes of infectious diseases and on the reactions of the host to the pathogens. Although the advent of antibiotics and vaccines has certainly taken the dread out of many infectious diseases, the treatment of infection is still a fact of life. New pathogens are constantly being discovered, strains of old ones have developed resistance to antibiotics, making therapy more and more difficult, while incurable diseases like AIDS, rabies etc. are still with us. Infectious diseases have been known for thousands of years, although accurate information on their etiology has only been available for about a century. We focussed on the broad knowledge of the etiologic organisms causing disease and the pathogenetic mechanisms leading to clinically manifest infections into its users. This knowledge is needed for every individual and a prerequisite for the diagnosis, therapy and prevention of infectious diseases.

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Introduction:-

Human skin is perhaps the greatest organ in the body, representing around 10% of complete body weight. For an average human, it weighs generally 5kg and covers a surface space of 2 sq. mt. Skin comprises of Epidermis, dermis, and hypodermis¹. The epidermis is the top layer of the skin, and it is composed of keratinocytes, which are quickly separating undifferentiated organisms that help produce epidermal cells². The dermis, the subsequent layer, is comprised of collagen strands in a gel-like state, just as fibroblasts. It supports the limiting of the epidermis, permitting it to adjust to the state of the body. The subcutaneous layer, which is the most profound layer of the skin, is for the most part comprised of greasy tissue³.

The outside skin layer's essential occupation is to give a solid obstruction that secures the whole body. It fills in as the underlying line of protection⁴. It secures against radiation, infection, gases, poisons, and an assortment of other destructive substances. Skin conditions contribute 1.79% of the worldwide weight of infection around the world⁵. American Academy of Dermatology Association reports that 1 out of 4 individuals in the United States have a skin infection. Skin is susceptible to different contaminations brought about by various microorganisms like microscopic organisms, growths, protozoa, infections. Around 0.15% skin illnesses are brought about by organisms⁶.

Corresponding Author:- Lakshmi Prasanna Sanikommu

Address:- Department of Biotechnology, Koneru Lakshmaiah Education Foundation, Guntur, Andhra Pradesh, India.

Fungus

A fungus is a primitive organism. There are millions of species of fungi. They can be plant on the soil, on shops, on shells around the house, and on your skin. Mycosis, or fungal infection, is a complaint caused by fungus⁷. Different kinds are generally classified as superficial, subcutaneous, or systemic, depending on where area of the body is tormented. Tinea pedis, tinea corporis, tinea corporis, tinea Eumycetoma and chromoblastomycosis are two subcutaneous kinds that affect apkins in and under the skin. Cryptococcosis, histoplasmosis, pneumocystis pneumonia, aspergillosis, and Mucor mycosis are exemplifications of systemic fungal conditions. A fungal infection within or beneath the skin can beget a bulge and skin changes⁸. People with a weakened vulnerable immune system are more susceptible to contract it. This includes persons who have HIV/ AIDS and those who are entering specifics like steroids or cancer curatives. Provocations, moulds, and fungi that can survive as both a mould and a incentive are among the fungi that beget ails in humans. In certain cases, defiled towel must be surgically removed. Fungal infections are current and have a global distribution, impacting about one billion individualities each time. In 2020, an estimated 1.7 million people will die from fungal illness. Several conditions are overlooked, including sporotrichosis, chromoblastomycosis, and mycetoma⁹.

Aspergillus Niger-

Aspergillus Niger is a fungus that belongs to the rubric Aspergillus. It's one of the most current species in the rubric Aspergillus¹⁰. It's a common food adulterant that produces a sickness known as "black earth" on colorful fruits and vegetables similar as grapes, apricots, onions, and peanuts. It's plant in soil and is constantly recorded from interior situations, where its black colonies are incorrect for Stachybotrys (species of which have also been called "black earth"). Some strains of A. Niger have been claimed to induce strong mycotoxins nominated ochratoxins; still, other sources dispute this assertion, suggesting that the fungus species was misapplied¹¹. Aspergillus Niger is classified as part of the Aspergillus subgenus Circumdati, section Nigri. A. tubingensis, A. foetidus, A. carbonarius, and A. awamori are among the 15 black-spored species in the Nigri section that may be incorrect with A. Niger. Samson et. al. reported a number of morphologically analogous taxa in 2004. The ATCC 16404 Aspergillus Niger strain was reclassified as Aspergillus brasiliensis in 2007. This needed an update to the United States Pharmacopoeia and the European Pharmacopoeia, both of which are extensively used in the pharmaceutical sector¹².

Implications-

Onions and cosmetic shops are infected with Aspergillus Niger, which produces sooty earth. A. Niger infection of onion seedlings can come systemic, appearing only when the conditions are right. A. Niger produces a frequent onion postharvest complaint in which black conidia can be seen between the bulb's scales¹³. Peanuts and grapes are also affected by the fungus. Aspergillus Niger is less likely than other Aspergillus species to beget mortal complaint. Humans may come bad in exceedingly rare cases; still, this is due to a deadly lung illness known as aspergillosis. Horticultural workers who gobble peat dust, which can be high in Aspergillus spores, are particularly susceptible to Aspergillosis. The fungus has also been discovered in ancient Egyptian grave corpses, which may be breathed when disturbed. Otomycosis (fungal observance infections) caused by A. Niger can beget discomfort, temporary hail loss, and, in extreme cases, damage to the observance conduit and tympanic membrane¹⁴.

The artificial turmoil of A. Niger produces a variety of precious enzymes. For illustration, A. Niger glucoamylase (P69328) is used to make high-fructose sludge saccharinity, while pectinases (GH28) are employed in the clarifying of cider and wine¹⁵. Beano and other flatulence-reducing products contain nascent galactosidase (GH27), an enzyme that breaks down certain complex carbohydrates. In the biotechnology sector, A. Niger is also used to make glamorous isotope-containing performances of natural macromolecules for NMR disquisition. Due to its strong affinity for D-glucose, Aspergillus Niger is also grown for the birth of the enzyme glucose oxidase (P13006), which is employed in the creation of glucose biosensors. Gold, tableware, bobby, iron, and zinc cyano-essence complexes were plant in Aspergillus Niger growing in gold-mining results. The fungus also aids in the dissolution of heavy essence sulphides¹⁶. A. Niger has also been plant to be able of resolving acid mine drainage by bobby and manganese biosorption. A. Niger that has been alkali-treated binds to tableware to the tune of 10 of its dry weight. Gray biosorption occurs by stoichiometric exchange with the sorbent's Ca (II) and Mg (II).

Mucor

Mucor is a microbiological rubric comprising about 40 mould species belonging to the Mucoraceae family¹⁷. Species can be plant in soil, digestive systems, factory shells, certain crapola, similar as Tomme de Savoie, decaying vegetable waste, and iron oxide residue left before after the biosorption process. Colonies of this fungus are typically white to faceless or slate in color, and they grow snappily. On culture media, colonies can develop to be several centimeters altitudinous. Due

to the growth of spores, aged colonies turn slate to brown in color. *Mucor* spores, also known as sporangiospores, develop apical, globular sporangia that are supported and raised by a column-shaped columella. They can be simple or branching. The form and insertion of the columella, as well as the lack of stolons and rhizoids, distinguish *Mucor* species from moulds of the rubrics *Absidia*, *Rhizomucor*, and *Rhizopus*. Chlamydospores are produced by several *Mucor* species. Earth is formed by non-septate hyphae raying at large angles ($> 90^\circ$) to induce irregular non-septate hyphae¹⁸.

Reproduction-

Asexual reduplication is used by *Mucor mucedo* (rubric species). The conformation of standing hyphal sporangiospores. The sporangiospore's tip expands, forming a globose sporangium with uninucleate, haploid sporangiospores. The columella is a sporangiospore outgrowth that protrudes into the sporangium. The sporangium walls are fluently damaged, releasing the spores, which germinate snappily and produce new mycelium on suitable shells. Compatible strains produce gametangia, which are small, technical hyphae that arise during sexual reduplication. A thick-walled, globular zygosporangium formed when two complimentary gametangia unite¹⁹.

Clinical Significance-

Due to their incapability to develop in heated conditions close to 37 degrees, utmost species of *Mucor* are unfit to infect humans and endothermic creatures. Zygomycosis is an opportunistic and constantly gormandize spreading necrotizing infection caused by thermotolerant organisms like *Mucor indicus*. Fungi warrant chlorophyll and are classified as saprophytes. That is, they get their food by breaking down non-living organic stuff. It's plant in saprotrophs and is constantly linked to fungus (similar as *Mucor*) and soil bacteria. Cellulitis is a skin illness that affects the soft apkins beneath the face. It occurs when bacteria enter a skin break and spreads. Cellulitis accounts for 0.04 of total skin conditions²⁰.

Bacteria-

Bacteria are wide, generally free-living brutes that are constantly made up of just one natural cell. They make up a broad group of prokaryotic organisms²¹. Bacteria play an important part in several stages of the nutrient cycle, similar as the obsession of nitrogen from the atmosphere. The corruption of dead cores is part of the nutrition cycle, and microorganisms are responsible for the corruption stage.

Pathogen:

Beneficial commensals, which live on the skin and mucous membranes, and saprophytes, which live mostly in the soil and decomposing debris, are constantly present in the human body²². The nutrients in blood and tissue fluids are adequate to support the development of many bacteria. The body possesses defense systems that allow it to withstand microbial invasion of its tissues and provide it with natural immunity or intrinsic resistance to numerous microbes. Each pathogen species has a distinct range of interactions with its human hosts. Skin infections, pneumonia, meningitis, and sepsis, a systemic inflammatory reaction resulting in shock, massive vasodilation, and death, can all be caused by bacteria such as *Staphylococcus* or *Streptococcus*. These organisms, on the other hand, are part of the natural human flora and can be found on the skin or in the nose without causing any sickness²³.

Serratia marcescens: -

Serratia is a Yersiniaceae genus of Gram-negative, facultatively anaerobic rod-shaped bacteria²⁴. *S. marcescens*, *S. aquatilis*, *S. entomophila*, *S. ficaria*, *S. fonticola*, *S. grimesii*, *S. liquefaciens*, *S. microhaemolytica*, *S. myotis*, *S. nematodiphila*, *S. odoriferae*, *S. oryzae*, *S. proteamaculans*, *S. quinivorans*, *S. qui*. They may be found in water, soil, plants, and animals and are normally 1–5 μ m long. They do not form spores and can be found in water, soil, plants, and animals. *S. marcescens* is the most common, accounting for around half of all strains discovered.

Serratia aquatilis is a new *Serratia* species discovered in drinking water²⁴.

Cellulitis is a skin illness that affects the soft tissues beneath the surface. It occurs when bacteria enter a skin break and spreads²⁵. Cellulitis accounts for 0.04% of total skin diseases. *Serratia marcescens* is a gram-negative motile facultative anaerobic bacillus from the Enterobacteriaceae family that has been linked to septic shock deaths. Individuals in immunocompromised states, such as diabetics and severe cirrhosis patients, as well as immunocompetent populations, have been found to be affected by this pathogen²⁶. Pneumonia, urinary tract infection, bacteremia, biliary tract infection, wound infection, meningitis, and endocarditis are among illnesses caused by *S. marcescens*. Cellulitis and necrotizing fasciitis (NF) are rare symptoms, although they can lead to severe sepsis and multiorgan failure. We present a case of cellulitis, bacteremia, septic shock, and multi-organ failure caused by an unusual cause²⁷.

Opportunistic human pathogen: -

S. marcescens, an opportunistic human disease, is considered to be spread by non-infected persons via hand-to-hand transfer, hospital equipment, and hospital employees. *Serratia* species prefer to invade the respiratory and urinary tracts in adults in hospitals rather than the gastrointestinal system. *Serratia* infection causes around 2% of nosocomial infections in the bloodstream, lower respiratory tract, urinary tract, surgical wounds, skin and soft tissues, and other conditions that are typically caused by other bacteria. In pediatric wards, outbreaks of *S. marcescens* meningitis, wound infections, and arthritis have occurred²⁸.

It is known to cause hospital and community acquired infections such as bacteremia, pneumonia, endocarditis, meningitis, and septic arthritis, but it is a rare cause of cellulitis or NF, especially in immunocompromised patients. Because the bacteria may be found in fresh, stagnant water, soil, and animals, community-acquired illnesses have been documented. *Serratia* bacteremia is caused by a community-acquired infection in around half of the cases (47 percent). Colonization can occur after earlier hospitalizations or operations, as our patient experienced after weekly paracentesis for end-stage liver illness and a recent catheterization for moderate aortic stenosis²⁹.

Pathogenesis: -

It is known to create the red pigment prodigiosin. The development of serralyisin (a protease enzyme), hemolysin Sh1A (a pore-forming exotoxin), and the formation of biofilm are all thought to have a role in pathogenesis. According to a mouse model, cell-mediated immunity in the spleen aids in the clearance of *Serratia marcescens*, hence splenectomized individuals are at a higher risk of severe soft tissue infection³⁰.

Treatment: -

Renal illness, chemotherapy, immunosuppressants, steroid, and liver disease are all linked to severe septic shock and significant mortality in immunocompromised people³¹. Pain, erythema, and edoema often appear within 24 hours of direct tissue damage in immunocompromised persons, and can show as painful nodules, solitary plaques, ulcer, cellulitis, abscess, granulomatous ulcer, pyoderma gangrenosum, and NF in immunocompromised individuals. Due to resistant bacteria, high-risk individuals might acquire severe bacteremia and septic shock quickly. Oral therapy with amoxiclavulanic acid is preferable, but intravenous therapy with β -lactamase inhibitors (ampicillin-sulbactam/piperacillin-tazobactam) is preferred. *Serratia marcescens*, like other Enterobacteriaceae, has inherent resistance to penicillin, macrolide, first-generation cephalosporin, linezolid, and rifampin. Resistance to penicillins, cephalosporins, and carbapenems can be chromosomal or plasmid-mediated, with either AmpC—lactamase, extended-spectrum-lactamase, or carbapenemase being produced³².

Conclusion:-

The importance of microbial interactions in health and disease has been increasingly recognised in recent years, and as a result, many researchers have abandoned the historical separation of pro- and eukaryotes and begun investigating co-colonization and co-infections across kingdom boundaries. These interactions are intricate, and the type of contact that happens is frequently determined by a variety of pathogen, environmental and host factors. Furthermore, understanding the pathways by which competing microorganisms counteract one another could lead to novel treatment options for serious human infections, which is now more than ever a critical need.

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