IMMUNITY AND MICROBIOLOGY

ESSAY

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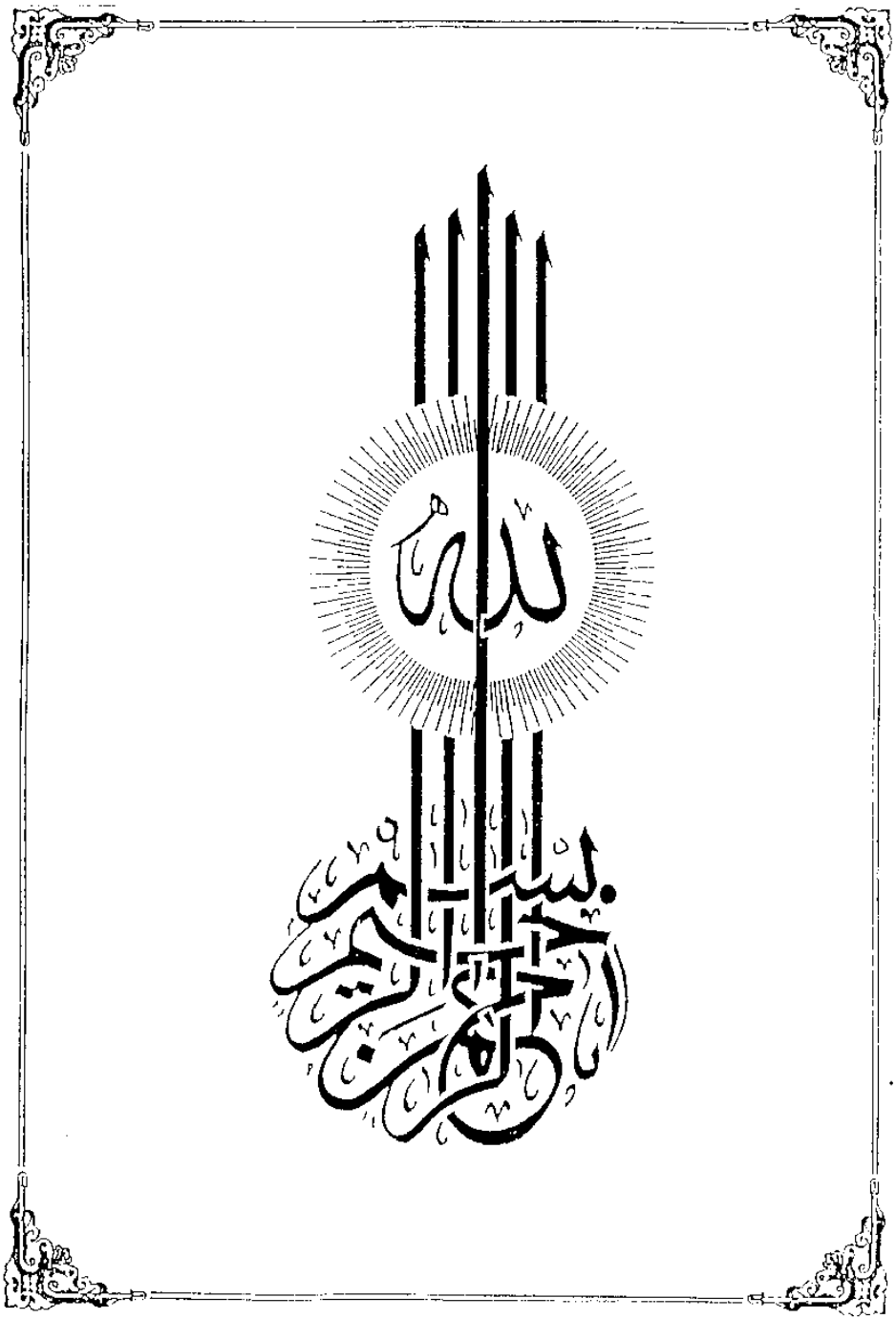

ACKNOWLEDGEMENT

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INTRODUCTION

CHAPTER I

HOST PARASITE RELATIONSHIP

HOST PARASITE RELATIONSHIPS

A parasite is an organism that resides on or within another living organism in order to find the environment and nutrients it requires for growth and reproduction. The most successful parasites achieve a balance with the host that ensures the survival, growth and propagation of both parasite and host, most of the host-parasite interactions do not result in disease.

In infectious diseases, there is struggle between the offending microbe and the manner in which the infected host responds to microbial invasion.

ATTRIBUTES OF MICROORGANISMS THAT ENABLE THEM TO CAUSE DISEASE

Pathogenicity denotes the ability of microorganisms to cause disease or result in the production of progressive lesions.

Virulence, which expresses the concept of degree i.e. virulent organisms exhibit pathogenicity.

It is measured by the median dose of micro-organisms or micrograms of their toxins necessary to kill, within a stated period of time, 50% of the animals inoculated known as LD_{50}.

Invasivenss

Is the ability to enter the host, multiply and spread.

Transmissibility (ID_{50}):

Dose required to cause a demonstrable infection in 50% of animals exposed.

TOXIGENICITY

The idea that bacteria may cause disease by producing toxins was first suggested by Loeffler in 1884. He noted that guinea pigs injected with diphteria bacilli subcutaneously produced wide spread systemic lesions where no bacilli could be found. He concluded that bacteria at the site of injection had generated a soluble poison, which disseminated by the blood stream.

Roux & Yersin in 1889 confirmed this conclusion when injecting bacteria-free filtrates, which produced the same identical disease. Microbial toxins are usually grouped as endotoxins or exotoxins.

Endotoxins are produced by many gram-negative bacteria. They are complex phospho lipid polysaccharide protein complex of the bacterial cell wall and are released into the surrounding medium only if the

organisms become autolysed or are artificially disrupted by mechanical or chemical means.

Endotoxins are generally less potent and less specific in their action than exotoxins. (Westphal and Luderitz) has shown that the biological activity of the bacterial cells reside in a lipopolysaccharide fraction, which can be separated from the phospholipid and all the protein of the original complexes by using phenol.

PATHOGENIC MECHANISMS CAUSED BY MICROBIAL EXOTOXINS

(1) Diphtheria

Toxins of corynbacterium diphtheriae inhibit protein synthesis and result in necrosis of epithelium, heart, muscle, kidney and nerve tissue. Diphtheria toxin is a polypeptide of (MW 62,000) that can be lethal in a dose of 40ng.

The essential action is inhibition of peptide chain elongation by inactivating the elongation factor EF-2 also called the transferase II factor.

(2) Tetanus

Vegetative forms of clostridium tetani produce toxins of (MW 150,000) that reaches the central nervous

system by retrograde axon transport and is bound to gangliosides.

According to Eccles it causes spasm by blocking the function of inhibitory synapses.

(3) Gas Gangrene

In the presence of necrotic tissue (anaerobic environment), spores germinate and produce toxins which are necrotizing and hemolytic, in the presence of distension of tissue by gas formed from carbohydrates and interferance of blood supply, favour spread of gangrene.

(4) Botulism

Clostridium Botulinum produces a neurotoxin of (MW 150,000) of 6 antigenic types.

This toxin affects both pre- and post-ganglionic synapses of the peripheral autonomic system as well as cholinergic mechanisms in peripheral motor nerves.

It also depresses the formation and release of acetyl-choline.

(5) Staphylococcal Food Poisoning

Certain strains of staphylococcus aureus produce an enterotoxin of (MW 40,000) which stimulates neural receptors in the gut, impulses are carried to medullary centers of gut motility.

(6) Cholera

Vibrio cholerae produce a heat-labile enterotoxin of (MW 28,000) which binds to ganglioside receptors on villi of small intenstine, causing large increase in adenylate cyclase activity and in the concentration of cyclic AMP in the gut. This results in massive hypersecretion of chloride and water and impaired absorption of sodium.

Table 1 - 1 shows principal toxigenic bacteria pathogenic to man

EXTRACELLULAR ENZYMES CLASSIFIED AS TOXINS

(1) Collagenase.

Clostridium perfringens produces this enzyme, which is capable of disintegrating collagen, which promotes the spread of bacilli in tissues. The α - toxin of the same organism is a lecithinase which damages cell membranes by splitting lecithin to phosphocholine and

Table 22-1. Exotoxins procedure by principal toxigenic bacteria pathogenic for Man

Bacterial species	Disease	Toxin	Action	Toxicity per mg, expressed as LD
Clostridium botulinum	Botulism	Six type-specific neurotoxins	Paralytic	1,200,000 (G)
Clostridium tetani	Tetanus	Tetanospasmin	Spastic	1,200,000 (G)
		Tetanolysin	Hemolytic cardiotoxin	
Clostridium perfringens	Gas gangrene	α-Toxin	Lecithinase necrotizing hemolytic	200 (M)
		γ-Toxin		
		δ-Toxin		
		ε-Toxin		
		η-Toxin	Necrotizing	
		θ-Toxin		
		κ-Toxin	Hemolytic cardiotoxin	
		λ-Toxin	Necrotixing	
		Toxin	Collagenase	
		Toxin	Proteolytic	
Clostridium septicum	Gas gangrene	α Toxin	Hemolytic	
Clostridium novyi	Gas gangrene	β Toxin	Necrotizing	50,000 (M)
		α Toxin	Lecithinase: necrotizing hemolytic	
		α-Toxin	Lecithinase: necrotizing hemolytic	
		δ-Toxin	Hemolytic	
		ε-Toxin	Lipase:hemolytic	
		δ-Toxin	Hemolytic	
Corynebacterium diphtheriae	Diphtheria	Diphtheritic toxin	Enzyme altering transferase II	3,500 (G)
Staphylococcus aureus	Pyogenic infections	Toxin	Necrotizing hemolytic leukocidic	50 (M)
		Enterotoxin	Emetic	
		Leukocidin	Leukocidic	
		Toxin	Hemolytic	
		Toxin	Necrotizing hemolytic	
		Toxin	Hemolytic, leucolytic	
Streptococcus pyogenes	Pyogenic infections and scarlet fever	Streptolysin O	Hemolytic	0.5 (M)
		Streptolysin S	Hemolytic	
		Erythrogenic	Causes scarlet fever rash	
		Streptococcal DP Nase	Cardiotoxic	
Pasteurella pestis	Plague	Plague	Necrotizing(?)	25 (M)
Bordetella pertussis	Whooping cough	Whooping cough toxin	Necrotizing	
Shigella dysenteriae	Dysentery	Neurotoxin	Hemorrhagic, paralyic	1,200,000

LD_{50}/kg denotes LD_{50}/kg of guinea pig (G), mouse (M) or rabbit (R)

diglyceride.

(b) Hyaluronidases

This enzyme also known as the "spreading factor" promotes diffusion through connective tissue by depolymerizing hyaluronic acid in the ground substance, facilitating bacterial invasion produced for example from staphylococci, strept, clostridia, pneumococci.

(c) Streptokinase (Fibrinolysin)

It is produced by many hemolytic streptococci has the ability to activate a proteolytic enzyme in the plasma which is then able to dissolve the clotted plasma.

(d) Hemolysins & Leukocidins

Many microorganisms produce substances that dissolve red cells and leuckocytes.

Streptococcus hemolyticus group A produces two types.:-

Streptolysin "O" which is hemolytic, antigenic but readily oxidized and thereby inactivated. But becomes reactivated by reducing agents.

Streptolysin "S" which is also hemolytic, but non antigenic and oxygen stable.

Hemolysins are also produced by staphylococci and many gram-negative rods.

Table 1-2 shows the difference between endotoxin and exotoxins.

ANTIBACTERIAL DEFENCES OF THE HOST

The contamination of the body, both externally on the skin or internally in the intestine, respiratory tract, and other tracts is inevitable.

Many of these surfaces are habitually colonized by organisms.

Whether contamination with a particular pathogen is followed by infection is dependant upon:

(a) The mechanical integrity of the body surface.
(b) Its powers of decontamination which varies from one type of tissue to another.
(c) General factors as the general state of health of the host.
(d) Immunological status of the host.