Proper Selection of Antibiotics in Ophthalmology

Essay
Submitted for partial fulfillment of Master Degree
in
Ophthalmology

By

Nada Abdel Salam Abdel Aziz
M.B., B.Ch - Ain Shams University

Supervised by

Prof.Dr Hoda M.Saber Naeim
Professor of Ophthalmology
Faculty of Medicine-Ain Shams University

Dr. Mahmoud Abdel Hamid
Assistant professor of Ophthalmology
Faculty of Medicine-Ain Shams University

Faculty of Medicine
Ain-Shams University
Cairo 2015

سورة البقرة الآية: ٣٢

Acknowledgement

I would like to express my gratitude to ***Professor Dr.Hoda Saber Naeim,*** *Professor of Ophthalmology, Faculty of Medicine-Ain Shams University for her helpful supervision and caring guidance.*

I would also like to thank assistant ***Professor Dr.Mahmoud Abd El Hamid,*** *Assistant professor of Ophthalmology, Faculty of Medicine-Ain Shams University for his valuable instructions, his thorough advice and kind assistance throughout this work.*

Nada A.El Salam

CONTENTS

CONTENTS (Cont.)

List of Abbreviations

AIDS	Acquired immune deficiency syndrome
ASCRS	American Society for Cataract And Refractive Surgery
b.i.d	Bis in die (Latin)=twice/day
CDC	Center of Disease Control and Prevention
DNA	Deoxy ribo-nucleic acid
ESCRS	Europian Society for Cataract and Refractive Surgery
EVS	Endopthalmitis Vitrectomy Study
FDA	Food and Drug Administration
MAC	Mycobacterium avium complex
MIC	Minimal inhibitory concentration
MRSA	Methicillin resistant staphylococcus aureus
MRSE	Methicilin resistant staphylocoocus epidermidis
OEHHA	Office of Environmental Health Hazard Assessment
PABA	Para-amino benzoic acid
PPV	Pars plana vitrectomy
q.i.d	Quarter in die (Latin)=four times/day
RNA	Ribo-nucleic acid
t.i.d	Ter in die (Latin)=three times/day
TASS	Toxic anterior segment syndrome
VISA	Vancomycin intermediate resistant staph aureus
VRE	Vancomycin resistant enterococci
VRSA	Vancomycin resistant staph aureus

List of Figures

List of Figures (Cont.)

List of Tables

List of Flow Charts

Introduction

Antibiotics are one of the great miracles of modern medicine. Selman Waksman, the microbiologist who discovered Streptomycin, first applied the word “antibiotic” in the medical sense in 1943. **(*Pramer, 1988)***

He defined antibiotics as "chemical substances that are produced by microorganisms and that have the capacity, in dilute solution, to selectively inhibit the growth of other microorganisms and even to destroy them"**. (*Pramer, 1988)***

With advances in medicinal chemistry, most modern antibacterials and antifungals are semi-synthetic modifications of various natural compounds or synthetic products generated as structural analogues of natural antibiotics**. *(Beale and Block, 2011)***

Meanwhile, the development of antivirals has lagged far behind that of antibiotics. Unlike antibiotics, antiviral drugs cannot destroy their target; instead they inhibit a virus from reproducing and developing. A virus is just a genetic material, DNA or RNA, wrapped in a protein coat. It is technically not alive, as it lacks key characteristics (such as cell structure) that are generally considered necessary to count as life. Further, a virus replicates by hijacking the machinery of the cell it infects, which makes it hard to kill without killing the cell**. *(Canchaya et al., 2003)***

The appropriate use of antibiotics to prevent infection continues to be a topic of great debate in ophthalmology. Antibiotics are not only prescribed to patients with ocular infections, but also as prophylaxis against microbial infections. ***(Puchalski, 2008; Kuehn, 2011)***

Normally, the eye is impermeable to most infectious agents. However, in some circumstances; infectious agents gain access to the eye such as;

(i) Following intraocular surgery.

(ii) Following a penetrating injury of the globe.

(iii) Following haematogeous spread to the eye from a distant anatomical site. **(*Mistlberger, 1997; Srinivasan et al., 1999)***

Infection of the eye includes; infections of eye lids, conjunctivitis, keratitis, dacryocystitis, preseptal cellulitis, orbital cellulitis, uveitis, endophthalmitis, panophthalmitis, etc. which are responsible for increased incidence of morbidity (blindness) worldwide. ***(Sharma, 1999)***

N.B.

This study is a non-profitable one. The trade names of the antibiotics mentioned in the study are the most commonly used in the market. They are mentioned for the aim of clarification.

Aim of the Work

The aim of this work is to give a re-orientation and review of the different classes and new generations of antibiotics. Also, to show the basis of selecting the appropriate antibiotics in ophthalmic practice. The study will also highlight the phenomenon of antibiotic resistance and the main misconceptions associated with the use of antibiotics.

Nature of the target pathogens

Living cells in our world come in two basic types; prokaryotic and eukaryotic. "Karyose" comes from a Greek word which means "kernel," as in a kernel of grain. In biology, we use this word root to refer to the nucleus of a cell. "Pro" means "before" and "eu" means "true" or "good." So "Prokaryotic" means "before a nucleus" and "eukaryotic" means "possessing a true nucleus". (***Stanier et al., 1962)***

Eukaryotes are organisms whose cells have a nucleus that holds the cell's DNA. Animals, plants, protists and fungi are all eukaryotes because they all have a DNA-holding nuclear membrane within their cells. ***(Gupta, 2000) (Mullen, 2001)***

Prokaryotes, on the other hand, lack this nuclear membrane. Instead, the DNA is part of a protein-nucleic acid structure called the nucleoid. Bacteria are all prokaryotes. ***(Gupta, 2000) (Mullen, 2001)***

The structural difference between the two groups is summarized in table(1) and in figure(1).

	Prokaryotes	**Eukaryotes**
DNA	DNA is naked (no histones)	DNA associated with histones
	DNA is circular	DNA is linear
	Genes do not contain introns	Genes may contain introns
	DNA found in cytoplasm (nucleoid)	DNA found in nucleus
Internal Structures	No membrane-bound organelles	Have membrane-bound organelles
Ribosomes	Have 70S ribosomes	Have 80S ribosomes
Reproduction	Asexual (binary fission)	Asexual (mitosis) or sexual (meiosis)
	DNA is singular (haploid)	DNA is usually paired (diploid or more)
Average Size	Smaller (≈1 – 5 μm)	Larger (≈10 – 100 μm)

Table (1): The structural differences betweeen prokaryotes and eukaryotes
(http://www.vce.bioninja.com.au/aos-1-molecules-of life/cells/eukaryotes.html)

*Histones**: are nuclear proteins that act as spools around which DNA winds. Without histones,the unwound DNA in chromosomes would be very long.***(Youngson & Robert, 2006)***

*Introns**: An intron is any nucleotide sequence within a gene that is removed by RNA splicing during maturation of the final RNA product. Introns do not encode protein products, but are integral to gene expression regulation. ***(ReaRick et al., 2011)***

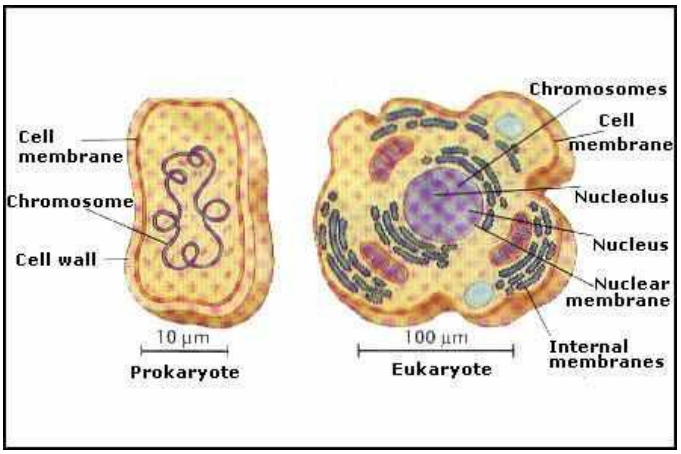

Figure (1): Prokaryotic and eukaryotic cell
(http://facts about cells.weebly.com/eukaryotic-and-prokaryotic.html)

Classification of Bacteria

Bacterial classification has been done on the basis of traits such as: shapes and arrangement, oxygen requirements, ability to form spores and reaction to Gram staining. **(Murray *et al., 2007*)**[1]

- **Shapes and arrangement**: figure (2)some common shapes of bacteria are:
  - Cocci: spherical in shape.
  - Bacilli: cylindrical or rod shaped.
  - Spiral: a curved rod, long enough to form spirals. They are spirilla if rigid and spirochaetes if flexible.
  - Vibrio: a short curved rod (comma shaped).

Many bacterial species exist simply as single cells, others associate in characteristic patterns, for example; Neisseria form diploids (pairs), Streptococci form chains, and Staphylococci group together in "bunch of grapes" clusters. Bacteria can also be elongated to form filaments, for example the Actinobacteria. Filamentous bacteria are often surrounded by a sheath that contains many individual cells. Certain types, such as species of the genus Nocardia, even form complex, branched filaments, similar in appearance to fungal mycelia. (***Young, 2006)***