Chapter 2
Emerging Strategies for Sensing of Blood-Stream Bacterial Diseases

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ABSTRACT

Early prognosis of infection has been a major concern for clinicians worldwide. The diagnostic investigation in clinical practice focuses on resolving the complex mysteries of the deep-seated systemic infections, which are often difficult to decipher. Amongst the infectious diseases, the bacterial infections are the most ubiquitously found infections. The clinics have moved to application of molecular imaging techniques for early detection of systemic bacterial infections which even allow the follow-up during antimicrobial therapy to assess the efficacy of a particular course. Further, new age diagnostic methodology has seen a paradigm shift to the detection of biomarkers in the blood samples of patients.

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1.1 INTRODUCTION TO INFECTION: HISTORICAL AND CURRENT PERSPECTIVE

In the past, primitive human populations most probably have suffered for long time from infectious diseases similar to diseases of other wild primate populations.

The chronicle of infection control began nearly 30 years before the discovery of *Vibrio cholera* by Robert Koch, a renowned microbiologist. It was the time when John Snow, a physician had found the epidemic spread of London cholera was due to faecal contamination of drinking water facility in the golden square locality. And in the case of AIDS(Acquired Immuno Deficiency Syndrome (AIDS), where causative organism retrovirus type of Human Immunodeficiency Virus (HIV) was identified in year 1984 long after its occurrence since 1981 (Moorhead, 2002).

Thus, an important activity in the field of medical research is discovery of pathogens which cause diseases in humans, and many bacteria, fungi, viruses, helminthes, protozoa and prions are recognized as potential pathogens.

The various types of systemic infectious diseases can be classified based on the causative organism and the description along with disease associated is mentioned in Table 1.

Despite advances in the comprehension of pathophysiology of infection at the molecular level, it remains one of the major causes of morbidity and mortality world-over, particularly in developing countries (Lopez, Mathers *et al.*, 2006; Kok, Pechère *et al.,* 2004).The infections of bacterial etiology are the most common in clinical practice. As per the World Health Organisation, (WHO) report (2008), billions of money is spent on healthcare in mitigation of infectious diseases globally. Of these infections which manifest the presence of viable bacterial load in the blood pool are categorized as Blood Stream infections (BSIs). Although, currently focus is on ongoing pandemic viral infection, significant global burden still remains bacterial pathogens. (WHO Fact Sheet, 2019).

There are two main reasons to this changing global scenario with rising cases of the communicable diseases. As humans are encroaching into the biomes, at the interface, there are 'hot-spots' for human transmission of new pathogens from the wild. This phenomenon has been shown by the most recent pandemics and epidemics like SAR-CoV-2 (Severe Acute Respiratory Syndrome Coronavirus 2 or COVID-19), SARS-CoV1, Ebola and Zika viral outbreaks, MERS (Middle East respiratory syndrome), chikungunya infections (CDC Report,2019). In addition to this, the looming secondary bacterial infections are result of low immune system following a viral illness(Langford BJ et al. 2020). Moreover, the irrational use of antimicrobial agents is leading us to the ever increasing number of drug resistant pathogenic bacteria.The rising rates of Antimicrobial resistance (AMR) is another area of public health threat as well as a significant cost burden to the global economy.

Automatic Detection of Blood Vessel in Retinal Images Using Vesselness Enhancement Filter and Adaptive Thresholding

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