Emerging glycobiology tools: A renaissance in accessibility

Abstract (600 words):

The glycobiology of the immune response is a topic that has garnered increased attention due to a number of key discoveries surrounding igg function, the specificity of some broadly neutralizing anti-HIV antibodies, cancer immunoregulation by galectin molecules and others. This review is the opening article in a Special Edition of *Cellular Immunology* focused on glycoimmunology, and has the goal of setting the context for these articles by providing a mini-review of how glycans impact immunity. We also focus on some of the technological and methodological advances in the field of glycobiology that are being deployed to lower the barrier of entry into the glycosciences, and to more fully interrogate the glycome and its function. Glycobiology is the study of carbohydrates, their conjugates, their enzymatic synthesis, modification, transport, and their binding partners. Like nucleic acids, lipids, and proteins, glycans impact the entirety of known biology, from the simplest of single cell organisms and viruses to humans. As a result, asking whether glycobiology impacts any particular biological phenomenon is akin to asking whether proteins are involved with a particular biological phenomenon. The answer is essentially always yes, though the impact could be direct or indirect. However, a number of characteristics, some intrinsic and others extrinsic, have blunted the size and relative impact of glycobiology over the decades. Intrinsically, glycobiology suffers from reductionism. Carbohydrate synthesis and protein glycosylation are driven by enzymes in a non-templated fashion, making the resulting output heterogeneous and difficult to predict. However, with the recognition that heterogeneous modification of the genome through non-templated and enzymatically-driven epigenetic changes has a powerful and even transmissible impact on our genetics , it is becoming appreciated that all biological and experimental systems have important and functional heterogeneity.

Importance of Research(200 words):

Glycans are nearly always the outermost component of all biological surfaces, collectively called the glycocalyx. From an immunological perspective, this makes them the major point of contact between immune cells and their ligands in the outside world. This is true for epithelial surfaces (*e.g.*, mucins) and the surface of mammalian cells (*e.g.*, glycoproteins, glycolipids, etc.), bacteria (*e.g.*, the O-chain of LPS, peptidoglycan, capsular polysaccharides, etc.), viruses (*e.g.*, capsid glycoproteins), and fungi (*e.g.*, β-glucans). Aside from a fundamental role in barrier integrity, the role of glycans in the immune response, or glycoimmunology, can be further divided into several subdivisions. First, the glycans themselves are important molecular determinants, ligands and antigens. Second, protein glycosylation can have a dramatic impact on the function, interactions and other properties of the underlying protein. Third, glycan binding proteins are a large and diverse family of molecules with wide ranging functions. Despite the common misconception that glycans are strictly T cell-independent antigens, MHCII is known to bind and present processed forms of bacterial polysaccharides to $CD4^+$ T cells for clonal recognition and activation , resulting in potent immunomodulation . Likewise, MHCI presents glycopeptides where the responding T cell

receptor makes most of its antigen contact with the glycan , and CD1 presents glycolipids to natural killer T (NKT) cells such that the glycan moiety is extended outside of the acyl chain binding pockets .

Biography (200 words)

Shamim Ahmad Bhat is working as a Consultant Emergency Medicine in Dept. Of Emergency Medicine King Saud Medical City Riyadh. He is a board certifi ed from India and currently holding the chair of Academic and research co coordinator in the same department. He is also holding the chair of deputy program director for Saudi diploma in emergency medicine. He is the director of the TRR (KSMC and ALFRED University) training in King Saud Medical City. He is a part of the panel of evaluators and examiners for Saudi board of Emergency Medicine, approved by Saudi commission for health specialties. He is a Specialist in Organization and Management and is a Certifi ed Tutor. He is a Lecturer, Trainer of medical personnel, education, social welfare, police, in the fi eld of diagnostics and organization of assistance to victims of violence

Info of Institute & Lab (200 words)

King Saud Medical City (KSMC), also known as Shemaisi Hospital, is a large public referral hospital and Level 1 Trauma Center in Riyadh, Saudi Arabia. It was founded in 1956 and is one of the largest tertiary care centers in Saudi Arabia, with a total bed capacity of 1,500 including 200 ICU beds. The 102-bed emergency department is the busiest in the country, and the hospital serves as the largest referral center in Saudi Arabia for Orthopedic surgery, Trauma surgery and Neurosurgery. It is part of the first healthcare cluster in the city of Riyadh, and currently employs 9,200 healthcare personnel.The hospital has a tremendously high patient turnover, both outpatient and inpatient, and conducted over 20,000 surgical procedures in 2019 alone.

KSMC is also one of the largest medical education, training and research centers in Saudi Arabia, with postgraduate residency and specialist training programs in medicine and surgical subspecialties as well as multiple medical school affiliations.

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