The staphylococcal surface-glycopolymer wall teichoic acid (WTA) is crucial for complement activation and immunological defense against Staphylococcus aureus infection

Abstract

Staphylococcus aureus is a Gram-positive bacterial pathogen that is decorated by glycopolymers, including wall teichoic acid (WTA), peptidoglycan, lipoteichoic acid, and capsular polysaccharides. These bacterial surface glycopolymers are recognized by serum antibodies and a variety of pattern recognition molecules, including mannose-binding lectin (MBL). Recently, we demonstrated that human serum MBL senses staphylococcal WTA. Whereas MBL in infants who have not yet fully developed adaptive immunity binds to S. aureus WTA and activates complement serum, MBL in adults who have fully developed adaptive immunity cannot bind to WTA because of an inhibitory effect of serum anti-WTA IgG. Furthermore, we showed that human anti-WTA IgGs purified from pooled adult serum IgGs triggered activation of classical complement-dependent opsonophagocytosis against S. aureus. Because the epitopes of WTA that are recognized by anti-WTA IgG and MBL have not been determined, we constructed several S. aureus mutants with altered WTA glycosylation. Our intensive biochemical studies provide evidence that the beta-GlcNAc residues of WTA are required for the induction of anti-WTA IgG-mediated opsonophagocytosis and that both beta- and alpha-GIcNAc residues are required for MBL-mediated complement activation. The molecular interactions of other S. aureus cell wall components and host recognition proteins are also discussed. In summary, in this review, we discuss the biological importance of S. aureus cell surface glycopolymers in complement activation and host defense responses.