

Group A Strep (GAS)

Kimberly Hyatt, RN, BSN, CPN, BA
Otterbein University, Westerville, Ohio

Introduction

The Group A Streptococcus (GAS) bacteria:

A large group of gram-positive, non-motile, non-spore-forming cocci.

- 120 different strains, most common bacterial pathogen. Easily treated with antibiotics, but widespread.
- Responsible for more than 700 million infections around the globe each year (Ermet et al., 2015).
- Untreated, can spread, become systemic, organ damage.
- Major health concern
- GAS ranks among the top 10 infectious disease killers worldwide" (Walker et al., 2014, p. 286).

The spectrum of diseases caused by GAS infections is divided into two categories: suppurative and non-suppurative.

Suppurative

Pharyngitis
Impetigo
Pneumonia
Empyema
Erysipelas
Necrotizing fasciitis
Cellulitis
Streptococcal bacteremia
Osteomyelitis
Otitis media
Sinusitis
Meningitis or brain abscess.
Non-suppurative
Acute rheumatic fever
Rheumatic heart disease
Acute glomerulonephritis
Scarlet fever
Endocarditis
Myocarditis
Pericarditis
Phlebitis
Streptococcal Toxic Shock
PANDAS

Disease burden:

- Globally, 500,000 deaths annually
- In U.S. GAS revealed a cost of \$500 million annually" (Steer et al., 2016).
- 9th leading infectious cause of human mortality globally
- 18.1 million cases of severe disease,
- 616 million cases of pharyngitis,
- GAS pharyngitis cost of at least \$500 million annually in US, alone. (Steer et al., 2016).
- Lethality 10-30%
- Annual death toll 500,000-650,000 (Terao, 2012).



Virulence Factors

- The most common forms, respiratory & skin infections,
- Highly virulent
- Overcoming host defense
- Effective/invasive in epithelial cells (Khan, 2016).
- Cell wall complex, chemically diverse.
- Outermost capsule hyaluronic acid
- Structure resembles host
- Escapes recognition
- Extracellular components: invasins and exotoxins,
- Host cell damage, inflammatory response (Khan, 2016).
- The antigenic components, virulence factors:
- Capsular polysaccharide (C-substance) (Khan, 2016).
- Peptidoglycan, lipoteichoic acid (LTA) (Khan, 2016).
- R and T proteins,
- Various surface proteins I,M protein (Khan, 2016).
- Cell streptokinase (Khan, 2016)
- CSA peptidase
- Bacterial Adhesion Factors (Khan, 2016).
- Streptolysin S-damages (Khan, 2016)
- Streptolysin O (Khan, 2106)
- Streptococcal pyrogenic exotoxins (SPEs) A,
- Liquefaction of pus, generates substrate for growth (Khan, 2016).
- Inhibition of complement system (Stevens & Bryant, 2015).
- Opacity Factors (Khan, 2016).



Reason for Study

The virulence factors and etiology of this bacteria make it a powerful pathogen that is capable of creating a large disease burden that can affect a family and a nation. Research is revealing genetic factors that increase and decrease susceptibility to a GAS infection. As this research continues, the quest to develop a GAS vaccine looks promising, but poses many challenges. These factors create several reasons why this powerful pathogen is a note-worthy topic, and one practitioners need to keep in mind.

Etiology:

- Highly communicable through person-to-person transmission
- respiratory droplets
- salivary droplets
- nasal discharge
- skin to skin spread known to occur with specific strains
- fingernails and perianal region can harbor streptococci causing impetigo
- food and waterborne outbreaks have been documented (Khan, 2016).
- Causes disease in healthy people of all ages
- Deficiency in specific type of immunity against serotype responsible for infection (Khan, 2016).
- Impetigo and pharyngitis more likely to occur among children living in crowded homes or suboptimal hygienic conditions (Khan, 2016).
- Bacteria can live on dry surfaces outside the body for 3 days to 6.5 months (Whiteman, 2013).

Pathophysiology and Significance of Pathophysiology

S. pyogenes colonization, usually in upper respiratory tract, and is highly virulent as it overcomes the host defense system.

Cell wall complex and chemically divers.

Antigenic components of cell are the virulence factors.

Extracellular components responsible for disease process include invasins and exotoxins.

Hyaluronic acid outermost capsule escapes recognition by host.

Bacterium escapes phagocytosis by neutrophils or macrophages, allowing colonization.

Epithelial cell invasion

Complement system activated

Classical pathway initiated by biding of antibodies to microbial surface

Lectin pathway activated by binding one or more lectins to specific carbohydrate structures

Alternative pathway triggered by 'tickover' mechanism followed by amplification through positive feedback loop

All three pathways converge at the level of C3 deposition

Formation of C3 convertases generates chemoattractant anaphylatoxins and further amplifies deposition of C3 fragments on microbes, which opsonizes the microbial target for efficient phagocytosis.

Gram-positive bacteria such as GAS are resistant to MAC-mediated lysis, but are eliminated by phagocytes following opsonization with C3b and iC3b.

The complement cascade is tightly regulated by surface bound and soluble inhibitors (or regulators); C4b-binding protein (C4BP) and Factor H (FH) are two examples of the latter which serve to prevent damage to host tissues (Ermet et al., 2015).

"GAS has evolved several virulence factors, which allow the pathogen to colonize its human host, escape the immune system and successfully establish infection" (Ermet et al. 2015, p. 2)

Fibrinogen binding to GAS reduces opsonization.

IgG Fc binding to GAS may prevent recognition by phagocyte Fc receptors.

M protein family members share high sequence identity. Certain M or M-like proteins mediate GAS binding to human C4BP and FH through Protein H, which is a member of M protein family.

Inhibition of complement activation through surface bound human FH and C4BP enables GAS infections to evade opsonization. (Ermet et al., 2015)



All Pictures from www.health247.com



Disease/Signs & Symptoms/ Nursing Care (select, please see paper for full list)

Pharyngitis-

Signs and symptoms include sore throat, fever, swollen lymph nodes, chills, malaise, nausea, and vomiting, red and white patches in the throat. Self-limiting, most signs and symptoms subside after 3 to 4 days, but antibiotic treatment should be started within 9 days after onset of pharyngitis to prevent acute rheumatic fever (ARF) development. **Nursing Care-** Prepare and administer prescribed antibiotics, analgesics. Educate patient/family on the proper use of antibiotics to prevent misuse. Encourage warm saline gargles, and use of throat lozenges, if recommended. Instruct the patient/family on proper mouth care and use of new toothbrush 24 hours after beginning antibiotics. Educate patient and family on the benefit of a bland, soft food diet until pain subsides. Advise patient/family on increased fluid intake to 2,000 mL/per day where appropriate. If patient cannot swallow, fluids may be administered by I.V. as ordered. Encourage client to wear a disposable mask when exposed to environmental and occupational pollutants. Assess and test family for intra-family spread of bacterial infection. (Clores, 2015)

Impetigo/Pyoderma-

Signs and symptoms include areas of acne or rash, small patches of inflamed skin, skin infections, oozing vesicles, honey colored crust and scales, hair loss, scratching, licking, and biting areas of infection, and depression.

Nursing Care- Teach proper washing and care of vesicles. Educate patient/family on proper use of antibiotics, both oral and topical. Educate on infection control and contagiousness of disease. Contact precautions should be initiated. Patient linens should be washed, kept separate from other family members. Teach good handwashing. Encourage patient to avoid irritants and pollution so additional bacteria and pathogens can be avoided until infection subsides. Keep fingernails cut short.(Antipuesto, 2011)

Invasive GAS infection-

Sign and symptoms include fever, severe pain, swelling, and redness at wound site. More systemic signs such as chills, myalgia, nausea, vomiting, and diarrhea may develop as disease/infection progresses. Changes in blood pressure may occur as disease progresses.

Nursing Care-Start and maintain I.V. line if indicated. Monitor temperature. Administer antibiotics as prescribed. Educate patient/family on proper use of antibiotics. Wound care, educating patient/family on appropriate wound care and infection prevention. Prepare and educate patient and family on debridement procedures where indicated. Encourage appropriate fluid intake and good nutrition. Assess and monitor patient for signs of sepsis. Prepare I.V. immunoglobulin G therapy if indicated for GAS TSS (Khan, 2016).

Glomerulonephritis

Signs and symptoms include blood, excess protein in urine, bubbly, foamy urine from presence of protein, high blood pressure, peripheral, facial edema, frequent night time urination, abdominal pain, and frequent nosebleeds.

Nursing Care- Provide best rest during acute phase. Monitor and regularly assess the patient's vital signs. Monitor lab values. Allow and assist with gradual return to normal activities as symptoms subside. Perform or teach passive range of motion exercises while on bed rest. Consult dietician about a diet high in calories, low in protein, sodium, potassium, and fluids. Educate on good hygiene, infection prevention Monitor daily weight, I and O. Assess for and report any sign of peripheral edema or formation of ascites. Explain orthostatic hypotension if patient is on diuretics, and the dizziness when quickly changing positions. Provide emotional support to the patient and family. If dialysis is ordered, fully explain the process to patient and family (Nursing File, 2010).

Conclusion

GAS is an important pathogen responsible for 700+ million infections worldwide annually. The global burden of invasive strep is 1,663,000 new cases, 163,000 deaths each year (Ermet et al, 2015). Quick identification & treatment of GAS is paramount to control, arrest the disease process, and prevent further complications. It is important to prevent spread,. GAS can spread easily between humans with close contact,; droplet spread. Antibiotic therapy treat most GAS infections if caught & identified quickly. The effective practitioner needs to be aware of the prevalence of GAS infections and assess patients, as is appropriate. No age group or people group is completely immune to GAS. Further research on a GAS vaccine would prove valuable, and once developed, the vaccine may help relieve some of the worldwide disease burden of this powerful pathogen.

Select References

(see paper for full list)

Ermet, D., Shaughnessy, J., Joeris, T., Kaplan, J., Pang, C., Kurt-Jones, E., ...Blom, A. (2015). Virulence of Group A Streptococci is Enhanced by Human Complement Inhibitors. *PLOS Pathogens*, 11 (7): 1-20. doi.org/10.1371/journal.ppat.1005043
Khan, Z. (2016). Group A Streptococcal Infections: Background, Pathophysiology, and Etiology. *Medscape*. Retrieved from http://emedicine.medscape.com/article/228936
Steer, A., Carapetis, JR., Dale, J., Fraser, J., Good, M., Guilherme, L., Moreland, N.,...Smeesters, P. (2016). Status of Vaccine Research and Development of Vaccines for *Streptococcus pyogenes*. Prepared for WHO PD-VAC. 34 (26) 2953-8: doi 10.1016
Stevens, D., Bryant, A. (2015). Group A streptococcus: Virulence factors and pathogenic mechanisms. *UpToDate*. Retrieved from <http://www.uptodate.com/contents/group-a-streptococcus-virulence-factors-and-pathogenic-mechanisms>
Walker, M., Barnett, T, McArthur, J., Cole, J., Gillen, C., Henningham, A., Sriprakash, K., Sanderson-Smith, M., Nizet, V. (2014). Disease Manifestations and Pathogenic Mechanisms of Group A *Streptococcus*. *Clinical Microbiology Reviews (CMR)*, 27(2), 265-307. Retrieved from <https://www.ncbi.nlm.nih.gov/pubmed/24696436>