International Journal of Multidisciplinary Research and Publications
ISSN (Online): 2581-6187

Gastrointestinal Colonization by Staphylococcus aureus Strains as Risk Factor for Different Infections (Brief Review)

Shorena Khetsuriani
Tbilisi State Medical University, Tbilisi, Georgia

Abstract*—Staphylococcus aureus, although identified as a commensal, is also a common cause of human bacterial infections. Certain strains of S. aureus are more competent colonizers than others. Their adhesion and virulence factors play a role in the switch from intestinal colonization to infection. Itn this review is disscused some aspects of gastrointestinal carriage of S. aureus and its involvement in some diseases. More studies will be needed to deep understanding of the importance of intestinal S. aureus colonization and its association with different diseases*.

***Keywords*—** *S. aureus, multi-drug resistance, carriage of S. aureus, intestinal colonization*.

S. aureus Infectious diseases remain one of the most prevalent causative agents of infections and leading agent of death worldwide. Although Staphylococcus aureus is a commensal microbe, it has the potential to cause a wide range of diseases [1]. S. aureus is the most isolated human bacterial pathogen and an an important cause of broad spectrum of infections - boils, abscess formation, wound infection, septic arthritis, sepsis/septic shock, pneumonia, osteomyelitis, foreign body infections and endocarditis [2,3]. It is also often responsible for toxin-mediated diseases (toxic shock syndrome, scaled skin syndrome, and staphylococcal foodborne disease) [4]. S. aureus is a common cause of infections in patients in intensive care units in many countries. One of the reasons for the success of this human pathogen is its variability, occurring at different times and countries [5].

Currently, S. aureus is the main common cause of nosocomial infections, and as an increasing number of community acquires infections, is an increasing public concern [6]. In addition to its ability to outwit human immune system, its multi-drug resistance phenotype, particularly – in methicillin-resistant S. aureus (MRSA) strains makes it one of the most intractable pathogenic bacteria in the history of antibiotic chemotherapy [7,8]. S. aureus is a common cause of infections in patients in intensive care units, and in many countries, MRSA is one of the most common causes of clinical infections worldwide and has attracted significant public attention due to the increased mortality associated with multidrug resistantce [9,10]. Nowadays, treatment failures are associated with multidrug resistant S. aureus strains also.

More than 100 trillion microorganisms live in the human intestine. They play an important role in health status and diseases, including cancer. S. aureus may cause nosocomial antibiotic-associated diarrhea [11]. Decreased stomach acidity can facilitate colonization due to easy passing the gastric-acid barrier [12]. An Intestinal overgrowth of bacteria causes enteritis and/or diarrhea. This bacterium is involved in inflammatory bowel disease also [13,14].

The bacterial species *S. aureus*, including MRSA, primaryly found in their ecological niche - the human nose, but is also can colonize the intestines and the perineal region. Colonization of the gastrointestinal system by S. aureus strains in hospitalized patients may lead to important clinical implications [4] and is able to acquire multiresistance [15,16]. Nasal colonization by *S. aureus* is a well-defined risk factor for different infections such as cutaneous, post-operative infections and other types of infections [17,18].

Prolonged colonization of *S. aureus* in the intestinal tract also occurs and results important clinical implications. Still, compared to nasal carriage, gastro-intestinal colonization by *S.* aureus has been sparsely studied.

The COVID-19 pandemic conditions increase MRSA incidences. Community accuired MRSA is now emerging as an apparent epidemic [19].

Changes in the interactions among the intestinal epithelial cells, intestinal microbiota, and host immune system are associated with many diseases, including cancer [10]. Besides of many factors (diet, family history, age, ethnicity), metabolic products of intestinal microbiota also influence and predispose to the development of colorectal cancer [9]. Some determinants of pathogenicity (urease, lecithinase production, hemolysis, proteolysis), also carbohydrate and mannitol fermentations in aerobic and anaerobic conditions are characterized with high activity in MDRSA and MRSA strains in comparison of non-MRSA strains These enzymes are involved in the pathogenesis of S. aureus infections [3].

Intestinal carriage of S. aureus may increase incidences of intestinal infections. Antibiotic therapy causes overgrowth of bacteria and induces enteritis or antibiotic-associated diarrhea. MRSA has been suggested as a cause of antibiotic-associated diarrhea in hospitalized patients [22].

Study results revealed compelling evidence of MRSA etiological role in antibiotic-associated diarrhea by excluding C. difficile, other bacterial pathogens and parasites, several enteric viruses in patients with enterotoxin-producing MRSA intestinal carriage [23].

S. aureus produce different enzymes, which are correlated with the virulence of bacteria. Secreted enzymes

Shorena Khetsuriani, "Gastrointestinal Colonization by Staphylococcus aureus Strains as Risk Factor for Different Infections (Brief Review)," *International Journal of Multidisciplinary Research and Publications (IJMRAP)*, Volume 5, Issue 12, pp. 130-131, 2023.

(exoenzymes) function to break down bacterial and host molecules for nutrient acquisition, bacterial survival, and dissemination [8]. For newborns MRSA intestinal colonization was detected in 1–2% and can be involved in the development of neonatal infectious disease. The colonization of the intestine with S. aureus in young children occurs at high frequency within the first 6 months of life, after which the frequency drops. Prolonged intestinal carriage among personnel can be an important factor of MRSA outbreaks in hospitals and become as important source of environmental contamination [19].

S. aureus strains are significantly spread in patients with different diseases as well as healthy persons. These strains revealed high anzymatic activity and intestinal carriage need to be considered as one of the significant factor for development of different dieseases.

REFERENCES

1. Jenul C and Horswill AR. (2018). Regulation of Staphylococcus aureus virulence. Microbiol Spectr. 6(1).
2. Mc callumn N, Berger-Bachi B and Senn M. (2010). Regulation of antibiotic resistance in Staphyloccus aureus. Int. J. of Med. Microb, 300(2-3), 118- 129.
3. Pochkhua K and Khetsuriani S. (2020). Enzyme secretion in Staphylococcus aureus strains. World Journal of Advanced Research and Reviews, 6(2), 110-112.
4. Khetsuriani Sh. et al., Isolation of multidrug-resistant Staphylococcus aureus strains from various body sites in patients with different infections J Med Microb Diagn 2019, Volume 08
5. Plata, K., Rosato, A. E., and Wegrzyn, G. (2009). Staphylococcus aureus as an infectious agent: overview of biochemistry and molecular genetics of its pathogenicity. Acta Biochim. Polon. 56, 597–612
6. Lowy FD. (1998). Staphylococcus aureus infections. N. Engl. J. Med., 339, 520-532.
7. Hanberger H. et al. increased mortality associated with methicilin-resistant Staphylococus aureus (MRSA) infection in the intensive Care Unit: results from the EPIC II study. International Journal of Antimicrobial,2011 DoL:10.1016/j.
8. Hiramatsu K, Katayama Y. et al. Multi-drug-resistant Staphylococcus aureus and future chemotherapy.J Infect Chemother. 2014 Oct; 20(10):593-601.
9. Mc Murray LW, Kernodle DS and Barg NL. (1990). Characterisation of widespread strains of methicillin susceptible Staphylococcus aureus associated with nosocomial infections J. Infect. Dis, 162, 759-762.
10. Barua S, Joshi A Sh and Swaminathan R. (2017). Prevalence of Multidrug Resistant Staphylococcus aureus and its Antimicrobial Susceptibility Pattern in a Tertiary Care Hospital in Navi Mumbai, India. Int. J. Curr. Microbiol. App. Sci, 6(3), 370-375.
11. Lane, Alison B., et al. "Methicillin-resistant Staphylococcus aureus as a probable cause of antibiotic-associated enterocolitis." Case Reports in Infectious Diseases 2018 (2018).
12. Yoshida, Y. MRSA strains proliferation in the rat gut is influenced by gastric acid inhibition and the administration of antibiotics. Surg. Today 1999. 29, 327–337. doi: 10.1007/s005950050414
13. Lu, J., Wang, A., Ansari, S., Hershberg, R. M., and Mckay, D. M. (2003). Colonic bacterial superantigens evoke an inflammatory response and exaggerate disease in mice recovering from colitis. Gastroenterology 125, 1785–1795. doi: 10.1053/j.gastro.2003.09.020).
14. Mergani A, Wanes D, Schecker N, Branitzki-Heinemann K, Naim HY and von Köckritz-Blickwede M (2021) Staphylococcus aureus Infection Influences the Function of Intestinal Cells by Altering the Lipid Raft-Dependent Sorting of Sucrase–Isomaltase. Front. Cell Dev. Biol. 9:699970. doi: 10.3389/fcell.2021.699970
15. Assis LM, Nedeljković M, Dessen A. New strategies for targeting and treatment of multi-drug resistant Staphylococcus aureus. Drug Resist Updat. 2017 Mar; 31:1-14.
16. Hassoun A, Linden PK, Friedman B. Incidence, prevalence, and management of MRSA bacteremia across patient populations-a review of recent developments in MRSA management and treatment.Crit. Care. 2017 Aug 14;21(1):211.
17. Kluytmans J, van Belkum A, Verbrugh H (1997) Nasal carriage of Staphylococcus aureus: epidemiology, underlying mechanisms, and associated risks. Clin Microbiol Rev 10:505–520
18. Wertheim HF, Melles DC, Vos MC, van Leeuwen W, van Belkum A et al (2005) The role of nasal carriage in *Staphylococcus aureus* infections. Lancet Infect Dis 5:751–762.
19. Acton, D.S., Tempelmans Plat-Sinnige, M.J., van Wamel, W. *et al*. Intestinal carriage of *Staphylococcus aureus*: how does its frequency compare with that of nasal carriage and what is its clinical impact?. *Eur J Clin Microbiol Infect Dis* 28, 115–127 (2009). https://doi.org/10.1007/s10096-008-0602-7
20. Roberta M. Manzat-SaplacanPetru A.,Balacescu M. et al Can we change our microbiome to prevent colorectal cancer development? ActaOncologica. 2015. Vol. 54, issue 8
21. Zitvogel L., Galluzzi L., Viaud S.,et al. Cancer and the gut microbiota: An unexpected link.SciTransl Med. 2015 Jan 21; 7(271): 271. Paper ID: ART20178764 DOI: 10.21275/ART20178764
22. 22. Gravet, Alain, et al. "Predominant Staphylococcus aureus isolated from antibiotic-associated diarrhea is clinically relevant and produces enterotoxin A and the bicomponent toxin LukE-LukD." *Journal of Clinical Microbiology* 37.12 (1999): 4012-4019.
23. Boyce, John M., Nancy L. Havill, and Benedicte Maria. "Frequency and possible infection control implications of gastrointestinal colonization with methicillin-resistant Staphylococcus aureus." *Journal of clinical microbiology* 43.12 (2005): 5992-5995.