Outbreak of Infections Caused by Group A *Streptococcus* after Modified Radical Mastectomy

Chen Qing-Zeng,^{1*} Sun Yun-Bo,^{2*} Liu Shi-Hai,³ Lun Li-Min,⁴ Ren Li-Juan,¹ Sun Ying-Juan,¹ and Pan Pi-Chun¹

Abstract

Background: Eight infections occurred after modified radical mastectomies in a tertiary-care hospital. Group A streptococci (GAS) were isolated from three of the eight patients.

Methods: To control the outbreak, an epidemiologic investigation was conducted, and healthcare workers were screened for pathogens. Strains isolated from healthcare workers were compared with patient strains by emm typing.

Results: One surgeon attended one of the eight operations and observed the other seven. *Streptococcus* strains from the hands of this surgeon were identical to the patient strains. After the surgeon was suspended from duty and underwent eradication treatment, the outbreak was controlled.

Conclusions: This outbreak of GAS infection is believed to have occurred by airborne transmission. Suspending patient care by healthcare workers who carry the causative GAS in a site(s) other than the respiratory tract for only the first 24 h they are receiving chemoprophylaxis may not be long enough. Sampling of the hands of healthcare workers during an investigation of nosocomial GAS infection is valuable.

POST-OPERATIVE Group A *Streptococcus* (GAS) infection is defined as an illness accompanied by the isolation of GAS from a normally sterile site or from a surgical incision in a patient for whom the indication for surgery was not an existing GAS infection [1]. Post-operative GAS infection is rare but could impose a heavy burden in the form of an outbreak.

Within two weeks, eight infections with highly similar symptoms and in which three patients had GAS-positive cultures occurred in one breast disease center, which is located in a university-based teaching hospital. This 600-bed hospital was opened five years ago. The number of inpatient operations in this center is about 1,400 per year. Contrary to the 19.1% surgical site infection (SSI) rate following breast operations reported by Angarita et al. [2], post-operative infections had been uncommon in this breast center, and most were mild, superficial incisional SSIs that followed routine administration of peri-operative prophylactic antibiotics. As a result, an infection control program was not emphasized by the hospital.

The series of post-operative infections in eight patients was investigated and controlled quickly. Here, we share the experience from this incident, and we offer insight into other

infection control practitioners and the role of surgeons in infections.

Patients and Methods

Case series

The eight cases (Table 1) occurred between November 22, and December 1, 2011. All of the patients had breast cancer and underwent modified radical mastectomy (followed by immediate reconstruction in case 3), with drainage tubes placed separately in the axillary space and near the sternum during the operation. On post-operative day 1, all but one patient showed signs of infection, with temperatures >39°C and a high white blood cell count ($\geq 13,000/\text{mcL}$). The exception was case 7, who presented with a temperature of 40.5°C on post-operative day 3. Purulent material was found in the drainage tubes of cases 2, 6, and 7, with no other signs such as flap necrosis, redness, heat, or localized swelling of the operative areas in any case. After immediate treatment with ceftazidime-sulbactam 3.0 g intravenously q 12 h and acetaminophen, the fevers subsided quickly. Group A streptococci were isolated from the blood of case 5 and from the drainage of two other patients.

¹Infectious Disease Office, ²Intensive Care Unit, ³Central Laboratory, and ⁴Clinical Laboratory, Affiliated Hospital of the Medical College, Qingdao University, Qingdao City, Shandong Province, China.

*These authors contributed equally to this work.

TABLE 1. INFECTED PATIENTS AND THEIR RELATIONSHIP TO THE SURGEON

Case	Date of operation	First fever	Bed group	GAS- positive site	Surgeon's role
1	Nov 22	Nov 23	A	None	Observer
2	Nov 23	Nov 24	B	None	Observer
3	Nov 23	Nov 24	B	None	Attendant
4	Nov 24	Nov 25	C	None	Observer
5	Nov 24	Nov 25	C	Blood	Observer
6	Nov 25	Nov 26	A	Drainage	Observer
7	Nov 30	Dec 03	D	Drainage	Observer
8	Dec 01	Dec 02	C	None	Observer (ca. 20 min)

Epidemiologic investigations

A definite case was defined as a patient from whom GAS was isolated from blood or surgical site drainage after operation. A probable case was defined as a patient with a temperature greater than 38°C within three days after operation who was located in the same ward as a definite case in this time period. For each case, the following information was collected: Diagnosis, type of skin preparation, date and time of operation, type of operation, operating room, attendant personnel, and environmental or other factors such as medical instruments that could have presented a risk of surgical site infection.

Microbiologic investigation

Medical materials, such as blades and talcum powder, used for skin preparation, water that was used for hand washing, antiseptic agents for surgical hand antisepsis, operative sutures, drainage tubes, and gelatin sponges for hemostasis were collected. Environmental surfaces such as doors and trolley knobs, operating astral lamps, and curtains from air disinfectors were swabbed. Swabs from the hands and pharynx of all of the surgeons, operating room (OR) nurses, anesthesiologists who attended any of the eight procedures, and healthcare workers (HCWs) in the breast center ward also were taken. Vaginal and anal swabs were not available. When the investigation began, the positive results of specimens from the patients were not available, so air in the OR was sampled by the standard sediment method, in which settling plates without sheep blood were exposed for 30 min. All of the materials and specimens were sent to the hospital clinical laboratory to isolate pathogenic bacteria.

All of the GAS isolates were analyzed by polymerase chain reaction (PCR) in the hospital central laboratory according to the protocol for emm typing from the U.S. Centers for Disease Control and Prevention (CDC) [3]. The PCR product was purified and sent to Sangon Biotech Co., Ltd. (Shanghai, China) for sequencing and identification.

Results

Epidemiologic results

No case was found in other wards. In the one year before this outbreak, no GAS was isolated from blood or drainage by the hospital clinical laboratory. The two ORs where the eight operations were performed, which were without central heating, ventilation, or air conditioning (HVAC) systems, had circulating wind ultraviolet air disinfectors that were located on a different floor from the main operating suite.

With an emphasis on limiting the use of peri-operative antibacterial prophylaxis, antibiotics have not been used in the peri-operative period since October 2011 in the breast center except for some circumstances, such as the implantation of prosthetic material and a contaminated procedure. Shaving was used to prepare the skin before operation.

The breast center consists of 40 beds divided into four groups (A, B, C, D). The eight cases were distributed among all four groups. During the first round of the investigation, none of the close contacts, who provided direct medical care to the affected patients during the pre-, intra-, or post-operative periods, was found to attend all or most of the eight patients. As a result, relatively close contacts who ever came near the case patients in the ward or the OR during the pre-, intra-, or post-operative periods were included in the investigation. At this time, one surgeon was found to be linked epidemiologically to all the cases. He was introduced to the center about one year before. To gain experience, this surgeon often observed operations in the OR. He attended the operation of case 3 to finish the immediate reconstruction of the breast and observed the other seven operations without a surgical care role. In one case, he was present for approximately 20 min. At the time of the outbreak, the surgeon had active atopic dermatitis on his face.

Laboratory results

No GAS was isolated from any of the medical materials, environmental surfaces, or air. Two specimens from the hands of the surgeon mentioned above were positive for GAS. The results from the specimen cultures from this surgeon are shown in Table 2. The results of emm typing of the two isolates from the culture-positive surgeon and each isolate from the three GAS-positive patients were identified as *Streptococcus pyogenes* strain emm 89.0.

Intervention and follow-up

The culture-positive surgeon was identified as the source of the infection. He quit operative duty on December 2, and several days later, he began treatment to eradicate GAS colonization. He received a regimen of amoxicillin 500 mg tid for 10 days, and rifampin 600 mg qd during the last four days of amoxicillin treatment, a regimen adapted from Mastro et al. [4]. After the completion of therapy and three consecutive negative culture results, the surgeon resumed his operative duty. There were no more cases after December 1, 2011.

TABLE 2. CULTURE RESULTS FROM SURGEON INVOLVED IN OUTBREAK

Date of sampling	Specimen location	GAS result	Surgeon's treatment status
Nov 29	Hands	Positive	–
Dec 8	Hands; pharynx	Negative	–
Dec 12	Hands; pharynx	Negative	Treatment start
Dec 14	Hands; pharynx	Positive from hands	–
Dec 21	Hands	Negative	–
Dec 22	Hands	Negative	Treatment end
Dec 23	Hands	Negative	–

Discussion

Group A streptococci inhabit patients and normal carriers, in whom the organism resides on the skin and mucous membranes [5]. Because humans are the only reservoir for GAS, HCWs and patients can be sources of infection. In this outbreak, no invasive procedure was performed before the operation, and the patients, who were not in a single group of beds, had no close contact with other infected patients. Therefore, patients could not be the direct source. Considering that the culture-positive surgeon was linked epidemiologically with all eight patients, that his strains were identical to the patient strains where this could be determined, and that infection control was successful after he quit operative duty, we believe that the culture-positive surgeon was the source of this outbreak. The lesions on his face may have been the reservoir of GAS. The silent state of the skin lesions or the routine use of antibiotics in the peri-operative period is believed to be the reason the outbreak did not occur earlier.

Group A *streptococci* are transmitted most often by inhalation of or contact with large droplet secretions. In this outbreak, the culture-positive surgeon did not carry the pathogen in his oropharynx and had close contact with only one affected patient, so airborne transmission of GAS is believed to have been responsible for the outbreak. The pathogen may have colonized some lesions on his skin. Scales of skin lesions with GAS may have been shed and aerosolized, inoculating the operative field and leading to the infections. The airborne transmission of GAS has been described or mentioned in several studies [4,6–8]. In one study, an obstetrician with rectal colonization by GAS had no close contact with two of nine case patients with post-partum infection, but he was present in the delivery suite; airborne transmission of GAS might have occurred in these cases [9]. In our investigation, settling plates without sheep blood did not recover GAS. Thus, the culture method of sampling may be a reason that no isolates of the pathogen were recovered from the air in our investigation, as blood-containing medium is optimal for recovery of GAS.

The surgeon was present in the OR for only about 20 min in case 8. This situation suggests that the length of time in which the bacterium disperses into the air and is aerosolized is brief. In the investigation by Mastro et al. [4], the technician source of the infection outbreak was not even present in the OR during the operation.

Hands have not been emphasized as a target of sampling in some investigations of GAS infection outbreaks [4,10–13]. Also, in the recommendations from the CDC, hands are not included as a target of investigation [1]. Interestingly, in the present study, specimens from hands played the crucial role

in tracing the carrier of the causative pathogen. We believe that lesions on the skin, throat, anus, and vagina, all niches for GAS, are important to investigate in an outbreak caused by GAS. However, in some circumstances, specimens from these sites are not available. Pathogens on hands can be a reflection of pathogens elsewhere on a person's body. Two of the hand specimens sampled before the eradication therapy began were negative, showing that pathogens on hands are transient. This low stability may have resulted from the skin's self-sterilizing ability or from hand hygiene. Nevertheless, we believe that sampling from the hands could be an important supplement, especially when the ideal specimens are not available. Moreover, the presence of GAS on the hands highlights the importance of hand hygiene in infection control.

To control an outbreak in which causative agent is transmitted by the airborne route and HCWs are carriers, excluding HCWs from duty is indispensable. Standard precautions such as wearing masks and hand hygiene are far less adequate. According to CDC recommendations, colonized HCWs should be suspended from patient care for the first 24 h they are receiving chemoprophylaxis [1]. In this outbreak, the specimen from the surgeon's hands was still positive for the pathogen two days after treatment. Previous studies focused mainly on the effectiveness of antibiotics in eradicating upper respiratory tract carriage of GAS [14–18]. There are few data on how long it takes to eradicate GAS from the skin lesions, anus, and vagina of asymptomatic colonized HCWs. We suggest that the HCW who is the source and carries the organism in a site or sites other than the respiratory tract should be excluded from duty until he or she has completed the antibiotic treatment and followup swabs do not yield the pathogen.

One of the goals of an HVAC system is to minimize the transmission of airborne pathogens [19]. In the present outbreak, the OR was not equipped with a central HVAC system. In the GAS outbreak investigated by Mastro et al. consisting of 20 post-operative SSIs, all ORs had unidirectional airflow, with more than 15 air exchanges per hour [4]. In another report of nosocomial infection of GAS in a tertiary-care center, two HCWs became infected from the aerosol of one patient in an OR that may have been equipped with an HVAC system [20]. The role of HVAC systems in preventing airborne transmission of GAS in the OR deserves further study.

Acknowledgments and Author Disclosure Statement

The authors acknowledge Yao Ruyong of the central laboratory and Jia Hongyan of the clinical laboratory for their assistance in this project.

No competing financial interests exist.

References

1. U.S. Centers for Disease Control and Prevention; Prevention of Invasive Group A Streptococcal Infections Workshop participants. Prevention of invasive group A streptococcal disease among household contacts of case patients and among postpartum and postsurgical patients. *Clin Infect Dis* 2002;35:950–959.
2. Angarita FA, Acuna SA, Torregrosa L, et al. Perioperative variables associated with surgical site infection in breast cancer surgery. *J Hosp Infect* 2011;79:328–332.
3. U.S. Centers for Disease Control and Prevention. Protocol for emm typing. Available at www.cdc.gov/ncidod/biotech/strep/protocol_emm-type.htm. Page last modified February 8, 2008. Accessed November 29, 2011.
4. Mastro TD, Farley TA, Elliott JA, et al. An outbreak of surgical wound infections due to group A *Streptococcus* carried on the scalp. *N Engl J Med* 1990;323:968–972.
5. Harvey RA, Champe PC, Fisher BD. Lippincott's Illustrated Reviews: Microbiology. Second edition. Philadelphia. Lippincott Williams & Wilkins, 2007.
6. Berkelman RL, Martin D, Graham DR, et al. Streptococcal wound infections caused by a vaginal carrier. *JAMA* 1982;247:2680–2682.
7. Gryska PF, O'Dea AE. Postoperative streptococcal wound infection: The anatomy of an epidemic. *JAMA* 1970;213:1189–1191.
8. Stamm WE, Feeley JC, Facklam RR. Wound infections due to group A *Streptococcus* traced to a vaginal carrier. *J Infect Dis* 1978;138:287–292.
9. Viglionese A, Nottebart VF, Bodman HA, et al. Recurrent group A streptococcal carriage in a health care worker associated with widely separated nosocomial outbreaks. *Am J Med* 1991;91(Suppl 3B):3B329s–3B333s.
10. Gordon G, Dale BAS, Lochhead D. An outbreak of group A haemolytic streptococcal puerperal sepsis spread by the communal use of bidets. *Br J Obstet Gynaecol* 1994;101:447–448.
11. Burnett IA, Norman P. *Streptococcus pyogenes*: An outbreak on a burn unit. *J Hosp Infect* 1990;15:173–176.
12. Whitby M, Sleight JD, Reid W, et al. Streptococcal infection in a regional burns unit and a plastic surgery unit. *J Hosp Infect* 1984;5:63–69.
13. Strus M, Drzewiecki A, Chmielarczyk A, et al. Microbiological investigation of a hospital outbreak of invasive group A streptococcal disease in Krakow, Poland. *Clin Microbiol Infect* 2010;16:1442–1447.
14. Snellman LW, Stang HJ, Stang JM, et al. Duration of positive throat cultures for group A streptococci after initiation of antibiotic therapy. *Pediatrics* 1993;91:1166–1170.
15. Morita JY, Kahn E, Thompson T, et al. Impact of azithromycin on oropharyngeal carriage of group A streptococcus and nasopharyngeal carriage of macrolide-resistant *Streptococcus pneumoniae*. *Pediatr Infect Dis J* 2000;19:41–46.
16. Tanz RR, Shulman ST, Barthel MJ, et al. Penicillin plus rifampin eradicates pharyngeal carriage of group A streptococci. *J Pediatr* 1985;106:876–880.
17. Tanz RR, Poncher JR, Corydon KE, et al. Clindamycin treatment of chronic pharyngeal carriage of group A streptococci. *J Pediatr* 1991;119:123–128.
18. Orrling A, Stjernquist-Desatnik A, Schalen C, et al. Clindamycin in persisting streptococcal pharyngotonsillitis after penicillin treatment. *Scand J Infect Dis* 1994;26:535–541.
19. Sehulster LM, Chinn RY, Arduino MJ, et al. Guidelines for environmental infection control in health-care facilities. Recommendations from CDC and the Healthcare Infection Control Practices Advisory Committee (HICPAC). Chicago. American Society for Healthcare Engineering/American Hospital Association, 2004.
20. Chandler RE, Lee LE, Townes JM, et al. Transmission of group A *Streptococcus* limited to healthcare workers with exposure in the operating room. *Infect Control Hosp Epidemiol* 2006;27:1159–1163.

Address correspondence to:

Dr. Chen Qing-Zeng

Infectious Disease Office

Affiliated Hospital of the Medical College

Qingdao University

16 Jiangsu Rd.

Qingdao City

Shandong Province, China, 266003

E-mail: chenqingzeng2002@yahoo.com