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A single-center, six-year evaluation of the role of pulsed-field gel electrophoresis in suspected burn center outbreaks☆

Heather C. Yun [a,b,*], *Charla C. Tully* [a,b], *Katrin Mende* [a,c,d], *Mayra Castillo* [e], *Clinton K. Murray* [a,b]

[a] *San Antonio Military Medical Center, JBSA-Fort Sam Houston, TX, USA*
[b] *Uniformed Services University of the Health Sciences, Bethesda, MD, USA*
[c] *Infectious Disease Clinical Research Program, Department of Preventive Medicine and Biostatistics, Uniformed Services University of the Health Sciences, Bethesda, MD, USA*
[d] *The Henry M. Jackson Foundation for the Advancement of Military Medicine, Rockville, MD, USA*
[e] *US Army Institute for Surgical Research, JBSA-Fort Sam Houston, TX, USA*

ARTICLE INFO

Article history:
Accepted 28 March 2016

Keywords:
Pulsed-field gel electrophoresis
PFGE
Burn
Epidemiology
Gram-negative bacteria
Outbreak

ABSTRACT

Introduction: Pulsed-field gel electrophoresis (PFGE) has been used as an adjunct to traditional hospital epidemiology in numerous outbreak investigations, including in burn centers. However, its most effective real-world application remains unclear, with few longitudinal descriptions of use.

Setting and methods: A 425 bed military tertiary hospital with a 40 bed burn center, from July 2007 to July 2013; retrospective evaluation of hospital infection prevention records was performed and results of PFGE where used in outbreak investigation.

Results: Twenty-two inquiries for suspected outbreaks were performed. 418 isolates were collected from 168 subjects during this time. 325 (78%) of the isolates originated from the burn intensive care unit. 17 inquiries were for gram-negative bacteria, comprised of 5 for *Acinetobacter baumannii-calcoaceticus* complex, 4 *Klebsiella pneumoniae*, 3 *Stenotrophomonas maltophilia*, 2 *Pseudomonas aeruginosa*, and 1 of each of the following: *Enterobacter cloacae*, *Raoultella planticola*, and *Aeromonas hydrophila*. The other 5 inquiries were specifically for *Staphylococcus aureus*. The majority of investigations revealed a combination of clonal and non-clonal isolates, and in no instance did PFGE contribute to targeting of interventions.

Conclusion: PFGE contributed little to infection prevention interventions, and outbreaks resolved with increased focus on basic practices. Longitudinal studies including greater numbers of outbreaks in different settings are needed to clarify the utility of molecular typing in routine investigations.

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* *Corresponding author at*: USAF MC, Infectious Disease Service, JBSA-Fort Sam Houston, 3551 Roger Brooke Dr., TX 78234, USA. Tel.: +1 210 916 5554; fax: +1 210 916 5900.
E-mail address: heather.c.yun.mil@mail.mil (H.C. Yun).

http://dx.doi.org/10.1016/j.burns.2016.03.021
0305-4179/Published by Elsevier Ltd.

1. Introduction

Since the advent of molecular epidemiology, a variety of methods have been used to determine relatedness of bacterial isolates in hospital outbreak settings, to enhance understanding of routes of transmission, and to define the effects of interventions. The most recent multidrug-resistant organism (MDRO) guidelines published in 2006 by the Centers for Disease Control and Prevention/Healthcare Infection Control Practices Advisory Committee (CDC/HICPAC) allude to the use of molecular techniques without offering specific recommendations for their use, and numerous reviews have examined the various methods available and their potential role in hospital infection prevention [1–3]. Pulsed-field gel electrophoresis (PFGE) has been used as an adjunct in decades of published evaluations of MDRO outbreaks [4,5]. However, despite the expansion of molecular tools available for use in hospital epidemiology, the ideal application of even older molecular tools remains unclear, and many hospitals do not have these capabilities either in the clinical microbiology laboratory or the hospital epidemiology division. Burn centers in particular have unique challenges associated with infection control, since endemic colonization and infection with MDR gram-negative organisms are common occurrences, and clonal outbreaks are also well described, causing serious morbidity and mortality [6]. Interventions to control these sometimes prolonged outbreaks have at times been drastic, including closure of units [7]. However, most of the published literature on the use of molecular epidemiology in the context of burn center infection control has been limited to reports of individual outbreak investigations.

Our facility has routinely used PFGE during outbreak investigations since 2007, most of which have taken place in the burn center. We sought to summarize and describe this experience as an effort to better inform the role of PFGE in these investigations both for our facility and similar centers.

2. Methods

This is a retrospective review of outbreak investigations, including bacterial culture results and clinical data from patients at San Antonio Military Medical Center (SAMMC), Joint Base San Antonio-Fort Sam Houston, TX, during a 6-year period (July 2007–July 2013) with focus on the United States Army Institute of Surgical Research (USAISR) Burn Center. Representative comparison investigations from non-burn ICUs within SAMMC and a local outside facility are also presented. SAMMC is a 425-bed level-1 trauma center, the largest hospital in the Department of Defense (DoD), and home of the sole burn center for the DoD. Prior to 2011, the USAISR Burn Center consisted of 16 unit beds divided among 2 units and 24 ward beds. In late 2011, the USAISR Burn Center was relocated upon completion of a new hospital wing, maintaining 16 ICU and 24 ward patient beds within one unit. The primary mission of the USAISR is to provide trauma, burn, and critical care to both military and the local civilian population in southern Texas. Military patients with burns receiving definitive care in the US are first evacuated from the area of combat operations in Iraq and Afghanistan to Landstuhl Regional Medical Center in Germany before transfer to the USAISR Burn Center. Local civilian burn patients are transported directly by emergency medical services or routed through a centralized South Texas referral system. Combat-injured burn patients arrive on average four days following injury while local civilians present within hours to days after injury. Standard burn patient care includes resuscitation and stabilization upon arrival with early burn wound excision and skin grafting. Vancomycin and amikacin are administered routinely perioperatively, with topical antimicrobial selection based on staff discretion. Routine infection control measures in the burn unit include private rooms, universal contact precautions and strict hand hygiene.

2.1. Process of outbreak investigation

Cultures were obtained when clinically indicated, during routine active surveillance for multidrug-resistant pathogens (as standard process for injured service members transferred from overseas), or occasionally for active surveillance specifically due to concern of an outbreak. An inquiry for possible outbreak was initiated, usually by a physician or Infection Prevention staff, when a cluster of at least 2–3 patients were noted with the same organism within a week, or when an unusual organism was noted. Epidemiological information was collected and isolates requested from the clinical microbiology laboratory for further evaluation with expanded susceptibility testing and PFGE.

2.2. Identification of organisms and antimicrobial susceptibility testing

Initial cultures were performed per Clinical Laboratory and Standards Institute (CLSI) guidelines in the clinical microbiology lab at our facility according to the type of clinical sample (such as blood, urine, wound). Identification and susceptibilities of clinical isolates were performed using the VITEK 2 (bioMérieux, Inc., Durham, NC) automated system in accordance with manufacturer's instructions. Further antimicrobial susceptibility testing requested by clinical staff was performed manually using Etest® (bioMérieux, Inc., Durham, NC). All MDROs were frozen and stored per laboratory protocol. When an outbreak was suspected, clinical and screening isolates of concern were forwarded on to the research lab for further susceptibility testing and PFGE. Bacterial isolates were recovered from frozen storage at −80 °C and passed twice on trypticase soy agar with 5% sheep blood (Remel, Lenexa, KS) prior to testing. Antimicrobial susceptibility testing in our research laboratory was re-performed using the BD Phoenix™ automated microbiology system (Becton-Dickinson, Franklin Lakes, NJ) per the manufacturer's instructions and utilizing NMIC/ID-123 or NMIC/ID-121 panels (Becton Dickinson Corp. Sparks, MD) for gram-negative bacteria and PMIC/ID-107 panels (Becton Dickinson Corp., Sparks, MD) for gram-positive bacteria. Susceptibility to antimicrobials was interpreted according to contemporaneous CLSI criteria [8].