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ORIGINAL ARTICLE

Infection control for a methicillin-resistant *Staphylococcus aureus* outbreak in an advanced emergency medical service center, as monitored by molecular analysis

Hidenobu Hidaka · Miho Miura · Kenji Masunaga · Liang Qin · Yusaku Uemura · Yoshiro Sakai · Kouji Hashimoto · Sayuri Kawano · Norio Yamashita · Teruo Sakamoto · Hiroshi Watanabe

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Abstract A methicillin-resistant *Staphylococcus aureus* (MRSA) outbreak occurred in an advanced emergency medical service center between 2010 and 2011. Our objective was to evaluate the status of the MRSA outbreak, as monitored by molecular analysis. Twenty-eight MRSA strains were isolated from blood samples from 11 patients, from other specimens (pharynx, nasal cavity, etc.) from 12 patients, from two environmental samples, and from the skin, middle nasal meatus, and urine of one patient each from other wards. Pulsed-field gel electrophoresis (PFGE) was performed to evaluate horizontal transmission. Molecular typing by PFGE showed that the 28 MRSA strains presented 7 patterns in total, and that 11 of the MRSA strains had the same PGFE pattern. Unselective use of intranasal mupirocin ointment, MRSA monitoring for new inpatients, and prevention of direct or indirect contact infection were performed. However, the number of inpatients with MRSA did not quickly decrease, and additional molecular typing by PFGE showed that 10 of 19 MRSA strains found (5 of 6 from blood, 5 of 13 from other specimens) were the same as those found previously. Lectures and ward rounds were performed repeatedly, and staff participation in ward rounds was suggested. Finally, the number of inpatients with MRSA significantly decreased more than 6 months after the intervention. Although the MRSA outbreak was thought to have ended, follow-up molecular typing by PFGE showed that horizontal transmission persisted. Our data suggest that various combinations of infection control measures are essential when dealing with an MRSA outbreak, and monitoring by molecular analysis using PFGE is useful to identify the status of the outbreak.

Keywords MRSA · Outbreak · PFGE · Infection control

H. Hidaka (✉) · K. Masunaga · L. Qin · Y. Uemura · Y. Sakai · H. Watanabe
Division of Infectious Diseases, Department of Infectious Medicine, Kurume University School of Medicine, 67 Asahi-machi, Kurume, Fukuoka 830-0011, Japan
e-mail: hidaka_hidenobu@kurume-u.ac.jp

H. Hidaka · M. Miura · K. Masunaga · H. Watanabe
Division of Infection Control and Prevention, Kurume University Hospital, Kurume, Japan

K. Hashimoto
Department of Clinical Laboratory Medicine, Kurume University Hospital, Kurume, Japan

S. Kawano · N. Yamashita · T. Sakamoto
Department of Advanced Emergency Medical Service Center, Kurume University Hospital, Kurume, Japan

Introduction

Methicillin-resistant *Staphylococcus aureus* (MRSA) is a major causative organism of hospital-acquired infection. MRSA strains easily colonize a host, particularly immunodeficient patients, and can cause a variety of serious infections [1–3]. The principal mode of transmission is via the transiently colonized hands of hospital personnel [4]. An outbreak of MRSA in intensive care units or neonatal intensive care units is often prolonged and can result in substantial morbidity and mortality [5, 6]. Although there are reports concerning the efficacy of the unselective use of intranasal mupirocin ointment to control MRSA outbreaks [7, 8], effective infection control measures still have not been established.

Molecular analysis is essential for evaluating horizontal transmission during an MRSA outbreak, and pulsed-field

gel electrophoresis (PFGE) remains the gold standard technique in this context [9–11].

In this report, we describe how an MRSA outbreak in our advanced emergency medical service center (hereafter referred to as the ICU) was brought under control through early recognition of the outbreak, monitoring by molecular analysis, and the stepwise addition of infection control measures.

Materials and methods

Ethical approval

All studies described herein were approved by the Human Ethics Review Boards of Kurume University (10268).

Setting and outbreak description

In Kurume University Hospital, there are 29 diagnosis and treatment departments, and 25 wards with 1,098 beds, including an ICU with 44 beds. The ICU in our hospital receives many severe patients via the ambulance and helicopter emergency medical services. The number of patients per month with newly identified MRSA colonization or infections including a positive blood culture in the ICU increased at the beginning in June 2010 (Fig. 1). Since an outbreak is defined as at least twice the usual number of cases in the same ward, the Infection Control Team (ICT) initiated an intervention for an MRSA outbreak in the ICU in August 2010.

Bacterial strains and patients

The first PFGE was performed against 28 MRSA isolates from blood samples of 11 patients (11 strains), and from other specimens (pharynx, nasal cavity, stool, sputum, ascites, and pus) of 12 patients (12 strains), the environment (2 strains), and the skin, middle nasal meatus, and urine of one patient each (3 strains) from other wards between April and September 2010. Since the number of inpatients with MRSA did not decrease quickly despite the initiation of various infection control measures, such as the unselective application of intranasal mupirocin ointment to inpatients, MRSA monitoring for new inpatients and measures for the prevention of direct or indirect contact were implemented. A second PFGE was performed against 19 MRSA isolates from blood, sputum, nasal cavity, skin, and pus in the ICU, and 3 MRSA strains each in neurosurgery, reconstructive and maxillofacial surgery, and cardiovascular medicine, where inpatients were occasionally transferred from the ICU between October 2010 and January 2011. Finally, even after the end of the MRSA outbreak in the ICU, a follow-up PFGE was performed

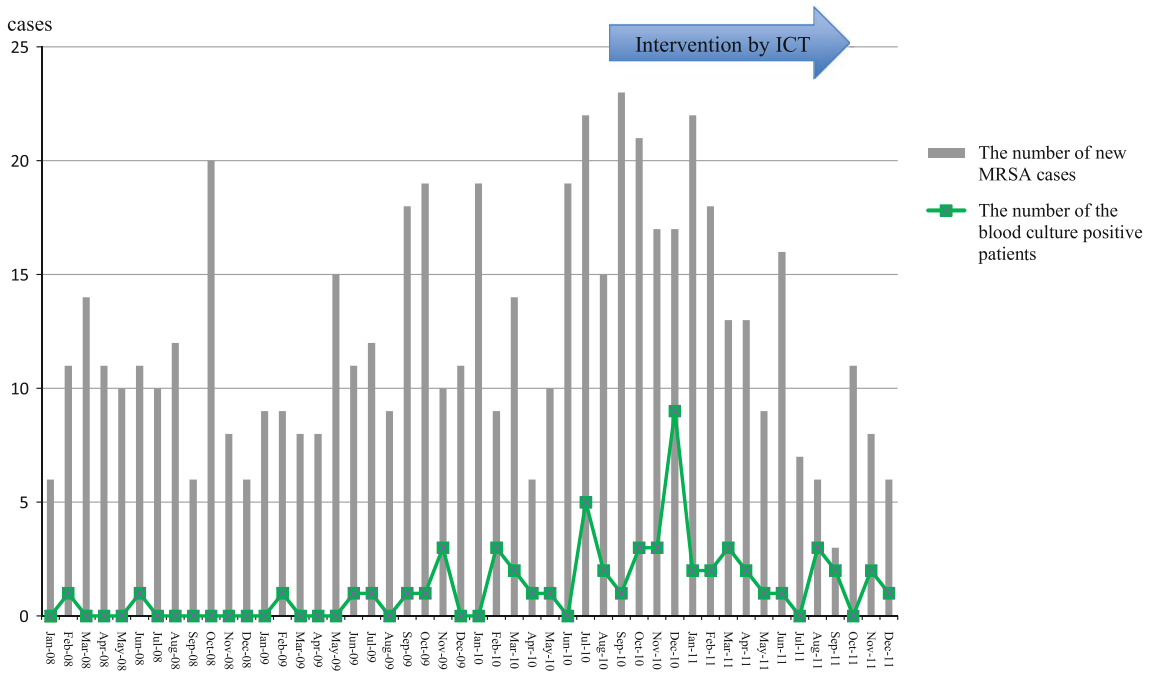

Fig. 1 Changes in the number of patients per month with newly identified MRSA colonization or infection (including a positive blood culture) in the ICU from January 2008 to December 2011. MRSA cases in the ICU with a positive blood culture increased dramatically from June 2010. After performing various kinds of interventions, the rate of MRSA infections decreased significantly more than 6 months after intervention was initiated