Case report

Contamination of inducible clindamycin resistant *Staphylococcus aureus* on the mobile phone of a Thai pharmacy university student: A case report

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Abstract

The antibiotic-resistant *Staphylococcus aureus* isolated from mobile phones (MPs) of university students was previously reported. However, few studies demonstrated an inducible clindamycin-resistant (ICR) strain. This study aimed to present the first case report of ICR and other antibiotic-resistant patterns of *S. aureus* isolated from the MP of a Thai male pharmacy university student. Isolated *S. aureus* from the MP of a 22-year-old Thai male pharmacy university student was taken to perform antimicrobial susceptibility testing using Kirby-Bauer disk diffusion method with cefoxitin (30 μg), clindamycin (2 μg), erythromycin (15 μg), penicillin (10 μg), gentamicin (10 μg), trimethoprim-sulfamethoxazole (1.25/23.75 μg), ciprofloxacin (5 μg), linezolid (30 μg) and tetracycline (30 μg). Additionally, D-zone test was investigated by placing the 15 mm of edge-to-edge between clindamycin and erythromycin disks. Resultswere interpreted by following the Clinical and Laboratory Standards Institute (CLSI) guidelines. We found that this isolate was resistant to erythromycin, tetracycline, and penicillin but susceptible to cefoxitin, clindamycin, trimethoprim-sulfamethoxazole, gentamicin, ciprofloxacin, and linezolid. Moreover, the flattening zone (D-shape) around clindamycin, particularly toward the erythromycin side, was observed, which indicated ICR *S. aureus*. Our findings emphasize the feasibility of persistent antibiotic-resistant including ICR ($iMLS_B$ genotype) *S. aureus* contamination in the MP of a university student. These may pave away for the awareness of using communication devices. Moreover, good personal hygiene and the use of proper MP cleaning procedures need to be announced to the user to reduce this phenomenon.

Keywords: Contamination, inducible clindamycin resistance, mobile phone, *Staphylococcus aureus*, university student.

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Staphylococcus aureus infection causes a wide range of diseases such as skin, soft tissue, respiratory, and endovascular infections including food poisoning.[1] Approximately, 20.0% of people are carriers for *S. aureus* and the proportion in children is higher than adults.[2] Generally, the different type of antibiotic-resistant *S. aureus* have been purposed, such as methicillin-resistant *S. aureus* (MRSA), vancomycin-resistant *S. aureus* (VRSA) and inducible clindamycin-resistant (ICR) *S. aureus*.[3 - 5]

Clindamycin is one of antibiotics in the macrolide-lincosamide-streptogramin B (MLS_B) group, which is used for treatment of skin and soft tissue infections caused by *S. aureus*.[4] ICR *S. aureus* has been reported and consequently affects patients' treatment, leading to clinical and therapeutic failure.[6] This phenotype can be found in both methicillin-susceptible *S. aureus* (MSSA) and MRSA, but the proportion in the former is smaller than the latter. Moreover, the prevalence of ICR *S. aureus* is higher in hospital than community environments.[4] In Thailand, the prevalence of ICR *S. aureus* was reported approximately 3.0% and 10.0% in MSSA and MRSA, respectively.[7]

Mobile phones (MPs) remain essential tools for university students in various aspects, e.g., communication, education, and entertainment. Previous findings revealed the presence of antibiotic-resistant *S. aureus* isolated from MPs of healthcare workers (HCWs) and university students.[8 - 12] However, few studies have been conducted in Thai university students' MPs and no evidence of ICR *S. aureus* contamination has been reported. Recently, our previous work described the presence of *S. aureus* isolated from MPs of Thai pharmacy university students.[13] We had continuously performed antimicrobial susceptibility testing and found one isolate of *S. aureus* comprised ICR pattern. Therefore, the objective of this study was to describe the first case report of ICR *S. aureus* contaminated on the MP of a Thai male pharmacy university student.

Case report

This study was the one part of the project "Prevalence and Antimicrobial Susceptibility of Microbial Contamination on Communication Devices of University Students", which had been approved by the Human Ethical Research Committee of Faculty of Dentistry and Faculty of Pharmacy, Mahidol University, Thailand (COA. no. MU-DT/PY-IRB 2017/034.1606).

The isolated *S. aureus* derived from the MP of a 22-year-old Thai male pharmacy university student, Who studied in the fifth-year class in 2017 was taken to perform antimicrobial susceptibility testing using Kirby-Bauer disk diffusion method with Mueller Hinton Agar (MHA) (Clinag, Bangkok, Thailand) with 9 commercially antimicrobial susceptibility disks (Oxoid™, ThermoFisher Scientific, Massachusetts, USA), which were cefoxitin (30 mg), clindamycin (2 mg), erythromycin (15 mg), penicillin (10 mg), gentamicin (10 mg), trimethoprim-sulfamethoxazole (1.25/23.75 mg), ciprofloxacin (5 mg), linezolid (30 mg) and tetracycline (30 mg). Moreover, the D-zone test was performed simultaneously for screening ICR *S. aureus* by placing the 15 mm distance of edge-to-edge between clindamycin and erythromycin disks. In addition, the standard stains of *S. aureus* ATCC 43300 (MRSA strain) and ATCC 25923 (MSSA strain) were used as control. All protocols and data interpretation were referenced to the Clinical and Laboratory Standards Institute (CLSI) guidelines.[14]

The results of antimicrobial susceptibility testing of *S. aureus* isolated from the MP were presented in Table 1. We found that this isolate was susceptible to cefoxitin, trimethoprim-sulfamethoxazole, gentamicin, ciprofloxacin, and linezolid but resistant to erythromycin, tetracycline, and penicillin. Moreover, we found a flattening zone (D-shape) around clindamycin disk, especially toward the erythromycin side (Figure 1). This indicated the presence of ICR *S. aureus* and this strain was interpreted as resistant to clindamycin.

Table 1. The results of antimicrobial susceptibility testing of *S. aureus* isolated from the MP of a Thai pharmacy university student.

Antimicrobial	FOX	E	DA	SXT	CN	TE	CIP	LZD	P agents
Results	S	R	R*	S	S	R	S	S	R

*The result represented the inhibition zone around clindamycin but illustrated the D-shape pattern near the edge of erythromycin. Therefore, the susceptible (S) to clindamycin was changed to resistance (R).
FOX = cefoxitin (30 μg); E = erythromycin (15 μg); DA = clindamycin (2 μg); SXT = trimethoprim/sulfamethoxazole (1.25/23.75 μg); CN = gentamicin (10 μg); TE = tetracycline (30 μg); CIP= ciprofloxacin (5 μg); LZD = linezolid (30 μg); P = penicillin (10 μg).

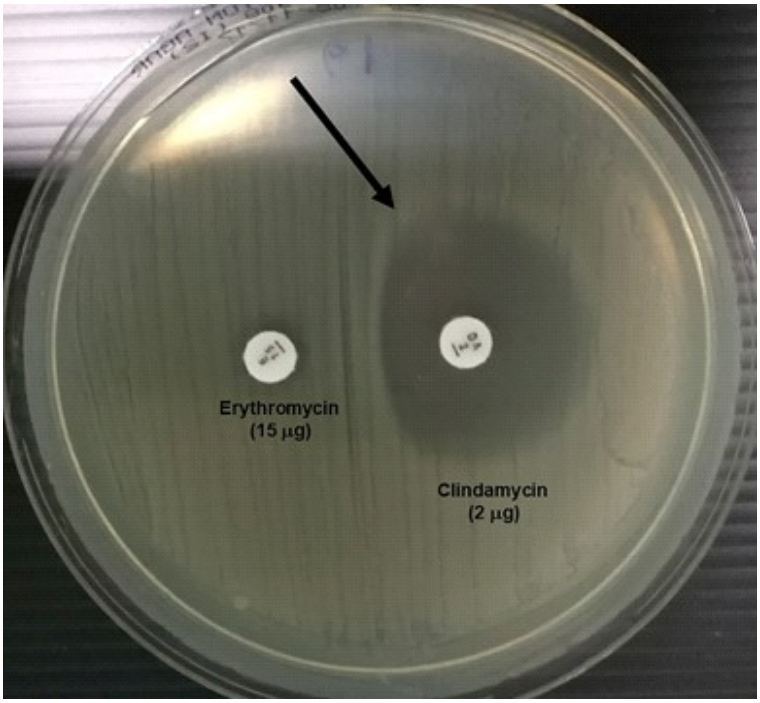

Figure 1. Inducible clindamycin-resistant pattern of *S. aureus* isolated from the MP of a Thai pharmacy university student (Black arrow).

Discussion

This study aimed to present the first case report of ICR *S. aureus* contaminated with the MP of a 22-year-old Thai male pharmacy university student. Prior investigating the antimicrobial susceptibility testing, we confirmed the previous identification result with Matrix-Assisted Laser Desorption/Ionization Time-of-Flight mass spectrometry (MALDI Biotyper®, Bruker, Germany).

Nine antimicrobial agents were selected for antimicrobial susceptibility testing by following the CLSI guidelines and the epidemiological data launched by the National Antimicrobial Resistant Surveillance Center, Thailand (NARST). [14, 15] Based on our findings, the presence of antibiotic-resistant patterns to some antimicrobial agents indicates that this MP is commonly contaminated with antibiotic-resistant *S. aureus*. Our findings are in accordance with previous studies conducted in both HCWs and university students. [8 - 12] However, our study is different from prior work in terms of groups of studies and lists of tested antibiotics. Although we found antibiotic-resistant *S. aureus* contaminated with the MP, this isolate is considered as MSSA due to the susceptible to cefoxitin. The MSSA-contaminated MPs has been previously reported in various cohorts in HCWs and university students. [9, 10, 12]

The occurrence of D-shape around the clindamycin disk reveals the presence of ICR *S. aureus* (iMLS$_B$ genotype) contamination on the MP. [5] This work not only supports the previous findings in Palestine university students [8] but also illustrates the first case report of ICR *S. aureus*-contaminated MP of a Thai male pharmacy university student. Moreover, our results suggest other types of antibiotic-resistant *S. aureus* contamination on a MP apart from MRSA. Additonally, we can also conclude that the bacterial contamination on this MP is MSSA with ICR. Although the evidence of ICR *S. aureus* is not included in the World Health Organization priority lists of antibiotic-resistant bacteria [16], it should be concerned and monitored to control the emergence of this resistant strain in both healthcare units and communities.

We ensure the reliability of our D-zone test result because we had followed the recommended guidelines for ICR *S. aureus* detection [14] and repeated tests remained consistent with results. However, we did not perform genotypic characterization by detection of *erm* gene. This gene involves in ribosomal methylation, the major mechanism related to ICR. [3] Although the genotypic assay is stated as the gold standard for ICR investigation, a previous study revealed that the use of 15-mm D-zone test is

comparable to molecular characterization as 100.0% sensitivity and specificity. [17]

Sources of persistent antibiotic-resistant microbes in MPs generally belong to personal behavior of device usage or the spread of endogenous microbes via hands, mouse, or ears during operation. In this study, we do not conclude the sources of persistently ICR *S. aureus*-contaminated MP. However, we can hypothesize that they may be related to personal behaviors of MP usage such as sharing a device with others, using it in a toilet, or using improper protocols for MP cleaning. Attending both medical and pharmaceutical microbiology subjects, especially in laboratory sections may also involve in the risk of microbial contamination on a MP. In our study, the participant did not enroll in these subjects during participating in this researh because he had already finished both laboratory and lecture courses since his third-year class and fourth-year class, respectively. Moreover, close contact with infected patients, carriage people, and contaminated fomites without standard hand-washing may allow the opportunity for microbial contamination with a MP. Furthermore, the spread of endogenous microbes, especially in a carriage of *S. aureus,* may involve contamination of antibiotic resistant *S. aureus* with a MP. This assumption is supported by previous findings revealing that ICR *S. aureus* was isolated from the nasal, throat, or palmar of carriers who experienced exposure with or without exposure to the hospital environment. [4, 18] However, we did not investigate the *S. aureus* carrier in the nasal or oropharynx of this subject.

The strength of this work is the first study describing ICR and other antimicrobial resistant patterns of *S. aureus* contamination on the MP of a Thai pharmacy university student. Nevertheless, the limitations of this study are only one case report and the lacking of genetic characterization of ICR *S. aureus*. For our suggestion, additional studies such as the prevalence of persistent ICR *S. aureus* on MPs of university students and genetic characterization need to be conducted. Moreover, sources and risks of MP contamination should be also investigated.

Conclusion

We first demonstrated the ICR *S. aureus* with other antibiotic resistance isolated from the MP of a Thai male pharmacy university student. These results provide other patterns of MP contaminated with *S. aureus* in addition to MRSA and can support the role of MP as the fomite for the persistence and transmission of antibiotic-resistant microbes. Additionally, sources of contamination may be related to MP usage behavior or *S. aureus* carriage. To reduce the risk of antibiotic-resistant bacteria that persist on a MP, awareness of device usage, including good personal hygiene, and the use of proper MP cleaning methods should be conducted regularly.

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Conflicts of interest statement

Each of the authors has completed an ICMJE disclosure form. None of the authors declare any potential or actual relationship, activity, or interest related to the content of this article.

Data sharing statement

The present review is based on the references cited. Further details, opinions, and interpretation are available from the corresponding authors on reasonable request.

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