Short Communication

First report of blaNDM-1-producing Acinetobacter baumannii isolated in Lebanon from civilians wounded during the Syrian war

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Abstract

Objective: The emergence of carbapenem-resistant Acinetobacter baumannii has been observed worldwide. We describe the first detection of A. baumannii carrying the blaNDM-1 gene in Lebanon, isolated from Syrian patients wounded during the civil war.

Methods: Four carbapenem-resistant A. baumannii strains isolated in 2012 in the Tripoli Government Hospital, Lebanon, from civilians wounded during the Syrian war, were analysed. Susceptibility was determined by disk diffusion testing, and resistance to carbapenems was confirmed by Etest. The presence of blaNDM-1-like, blaOXA-24-like, blaOXA-58-like, blaOXA-143-like, and blaNDM was investigated by PCR. Clonal relationships were studied by pulse-field gel electrophoresis (PFGE), multilocus sequence typing (MLST), and blaOXA-51 sequence-based typing.

Results: All isolates harboured the blaNDM-1 gene and were negative for other tested carbapenemases. They all belonged to the sequence type 85 and formed a single cluster by PFGE. Finally, blaOXA-51-like gene sequencing revealed the presence of the blaOXA-51 variant in all four isolates.

Conclusion: These findings show that Syria constitutes a reservoir for NDM-1-producing bacteria. These results also highlight the need for effective measures to stop the threatening spread of such strains.

1. Introduction

Multidrug-resistant (MDR) Acinetobacter baumannii are associated with a wide spectrum of infectious diseases, ranging from nosocomial and community-acquired infections to those acquired in natural disasters or war. The main mechanism of resistance to carbapenems in A. baumannii is the production of acquired OXA-type carbapenemases, encoded mostly by blaOXA-23-like, blaOXA-24-like, and blaOXA-58-like genes, which have been identified frequently worldwide. In 2008, New Delhi metallo-β-lactamase 1 (NDM-1), encoded by the blbNDM-1 gene and conferring resistance to all the β-lactams including carbapenems, was discovered in Enterobacteriaceae isolates isolated in Sweden from a patient hospitalized in India. Since this first description, the enzyme has been reported throughout the world as an emerging carbapenemase widely detected in clinical Enterobacteriaceae, but also in A. baumannii, in which the blaNDM-1 and blaNDM-2 genes have recently been identified.

Here, we report the first detection of carbapenem-resistant Acinetobacter baumannii carrying the blaNDM-1 gene in Lebanon, isolated from Syrian patients wounded during the civil war.

2. Materials and methods

2.1. Isolates and antimicrobial susceptibility testing

A total of four carbapenem-resistant A. baumannii isolates were analysed. Species identification was confirmed by real-time PCR of the blaOXA-51 gene and rpoB gene sequencing. Antimicrobial susceptibility was determined by disk diffusion, in accordance with the recommendations of the European Committee on Antimicrobial Susceptibility Testing (http://www.eucast.org).
and resistance to carbapenems (imipenem, meropenem, and doripenem) was confirmed by Etest diffusion (bioMérieux, Marcy l’Etoile, France).

2.2. PCR assays and molecular typing

Real-time PCR was done to screen for the presence of blaOXA-23-like, blaOXA-24-like, blaOXA-58-like and blaOXA-143-like genes.5 The presence of blaNDM genes was investigated by standard PCR amplification. Sequencing of the entire carbapenem resistance gene was performed.

Genotyping was performed by pulsed-field gel electrophoresis (PFGE) using Apal enzyme and multilocus sequence typing (MLST), in accordance with the Pasteur Institute instructions (http://www.pasteur.fr/mlst). Moreover, the blaNDM-1-like gene was sequenced and compared to all identified variants.

3. Results and discussion

The carbapenem-resistant A. baumannii presented here were admitted from civilians wounded in 2012 during the Syrian war and admitted to the government hospital of Kobbe, Tripoli, in northern Lebanon (Table 1). The four isolates had high-level resistance to carbapenems since the minimum inhibitory concentrations (MICs) for imipenem, meropenem, and doripenem were >32 mg/L. The isolates were also resistant to fluoroquinolones, but susceptible to aminoglycosides, doxycycline, tigecycline, rifampin, and colistin. They all carried the blaNDM gene and were negative for the other carbapenem resistance genes tested. Sequencing of the blaNDM gene showed that the variant was the blaNDM-1 gene in all four isolates.

Multidrug-resistant and blaNDM-1 gene-carrying A. baumannii are increasingly reported worldwide. Since 2010, they have been identified in various parts of the world, in particular in North Africa and the Middle East,6 but to our knowledge, this is the first report of carbapenem-resistant A. baumannii carrying the blaNDM1 gene in Lebanon. However, two NDM-1-producing Klebsiella pneumoniae imported from Iraq were detected in 2010.7 To date, no NDM-1-producing A. baumannii has been described in Syria; however this is a country where data on the prevalence of A. baumannii antibiotic resistance remain limited. Recently, Hamzeh et al. published a report in which 260 A. baumannii isolates from patients hospitalized in the area of Aleppo were studied.8 They showed that 66% of the isolates were resistant to carbapenems, but no further molecular epidemiological studies to explore resistance mechanisms were performed.

Outbreaks of MDR A. baumannii infections have been reported previously during war, as shown by Scott et al. and Kusradze et al., who studied the bacteria isolated in US service members injured in Iraq.9,10 However, no isolate harbouring a blaNDM-1 gene was found among the casualties. Although a majority of NDM-1-producing A. baumannii are isolated in the hospital setting, it is possible that the bacterium can be isolated from various environmental locations worldwide, even if the reservoir of such MDR isolates is not yet well known. In the present study, the origin of the A. baumannii infection in injured patients was difficult to determine. We were unable to obtain information on the date of injury, conditions of care, or on the treatment administered in Syria. The infection may have been acquired from environmental sources on the battlefield, during the patient’s stay in Syrian clinics, or during evacuation from the operation theatre to Lebanon.

The PFGE analysis showed that the four isolates shared identical patterns. The MLST analysis showed that all isolates belonged to sequence type 85 (ST85), and sequencing of the blaOXA-51-like gene identified blaOXA-94 as a unique variant. Reports of ST85-type strains worldwide are rare. Two A. baumannii belonging to the ST85 clone and carrying the blaNDM-1 gene have recently been described in France. Those strains were isolated from rectal swabs and harboured the blaOXA-94 variant.6

In conclusion, this study reports the spread of NDM-1-producing A. baumannii in Syria, showing that this country constitutes a reservoir for NDM-1-producing bacteria. This information is of major importance, since because of the civil war, many injured people are being transferred to foreign hospitals for treatment. Among these hospitals, those in Lebanon are the first affected. These results highlight the importance of implementing effective infection control measures to stop the threatening spread of such resistant microorganisms.

Acknowledgements

The authors thank the Lebanese University and the National Council for Scientific Research, Lebanon for their funding of this research. We thank Linda Hadjadj, Mariam Yehya, Aicha Borghol, and Tahra Abdou for technical assistance.

Conflict of interest: The authors declare that no conflicts of interest exist.

References


Table 1
Epidemiological data of the four carbapenem-resistant Acinetobacter baumannii carrying the blaNDM-1 gene isolated in Lebanon from Syrian war casualties

<table>
<thead>
<tr>
<th>Patient</th>
<th>Age/gender</th>
<th>Nationality</th>
<th>Isolation source</th>
<th>Hospitala</th>
<th>Admission date (DD/MM/YYYY)</th>
<th>Antibiotic susceptibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>24/M</td>
<td>Syrian</td>
<td>Wound, foot</td>
<td>TGH</td>
<td>29/05/2012</td>
<td>R R R R R S S S S S S</td>
</tr>
<tr>
<td>2</td>
<td>24/M</td>
<td>Syrian</td>
<td>Wound, foot</td>
<td>TGH</td>
<td>02/06/2012</td>
<td>R R R R R S S S S S S</td>
</tr>
<tr>
<td>3</td>
<td>14/F</td>
<td>Syrian</td>
<td>Wound, hand</td>
<td>TGH</td>
<td>14/06/2012</td>
<td>R R R R R S S S S S S</td>
</tr>
<tr>
<td>4</td>
<td>1/F</td>
<td>Syrian</td>
<td>Wound, shoulder</td>
<td>TGH</td>
<td>14/06/2012</td>
<td>R R R R R S S S S S S</td>
</tr>
</tbody>
</table>

IMI, imipenem; MER, meropenem; DOR, doripenem; CAZ, cefazidime; CIP, ciprofloxacin; GM, gentamicin; AM, amikacin; COL, colistin; TG, tigecycline; RIF, rifampin; DOX, doxycycline; R, resistant; S, susceptible.

a TGH, Tripoli Governmental Hospital, government hospital of Kobbe, Tripoli, in northern Lebanon.


