

NDM-1-Producing *Klebsiella pneumoniae* in Mauritius

The carbapenemase NDM-1 initially identified in *Escherichia coli* and *Klebsiella pneumoniae* in Sweden from a patient transferred from India (15) has been now identified in many enterobacterial species and isolates from patients mainly in the United Kingdom, India, and Pakistan (6) but also from many different countries in Europe, Asia, Africa, and North America (10). Most of these reports indicated a link with the Indian subcontinent, corresponding to either hospital or community acquisitions. Balkan countries have been also recently considered an additional reservoir for NDM producers (8).

Here we report an isolate from a 39-year-old male patient who was admitted to the surgery department of the Victoria Hospital, city of Quatre Bornes, Mauritius, in 2009. Urine samples grew a multidrug-resistant *K. pneumoniae* strain, and susceptibility testing performed and interpreted according to the updated CLSI guidelines (3) showed that it was resistant to all β -lactams, including carbapenems, to all aminoglycosides, and to fluoroquinolones, nitrofurantoin, chloramphenicol, and trimethoprim-sulfamethoxazole. It was susceptible only to tigecycline and colistin (MICs of 0.5 $\mu\text{g/ml}$ for both). According to phenotypic test results (synergy between aztreonam and clavulanate), *K. pneumoniae* CL produced an extended-spectrum β -lactamase (ESBL). Metallo- β -lactamase (MBL) detection performed by using the Etest combining imipenem and EDTA (AB bioMérieux, Solna, Sweden) gave a positive result. MICs of imipenem, ertapenem, doripenem, and meropenem determined by Etest for *K. pneumoniae* isolate CL were, respectively, 4, 12, 3, and 4 $\mu\text{g/ml}$. According to the CLSI updated guidelines (3), the isolate could therefore be considered resistant to those molecules, except for having intermediate susceptibility to doripenem. Unfortunately no information was available on the treatment and outcome of this patient.

PCR, sequencing, and plasmid analysis revealed that *K. pneumoniae* CL harbored the $bla_{\text{NDM-1}}$ carbapenemase gene (9), in addition to the ESBL gene $bla_{\text{CTX-M-15}}$, both of which were located on different plasmids (120 and 160 kb in size, respectively) (13). Screening for additional β -lactamase genes (13) and for 16S RNA methylase genes as reported previously (1) showed that *K. pneumoniae* CL was coharboring the $bla_{\text{CMY-6}}$, $bla_{\text{OXA-1}}$, $bla_{\text{SHV-28}}$, and $bla_{\text{TEM-1}}$ genes (a total of five β -lactamase genes) and the *rmtC* gene, encoding high-level resistance to all aminoglycosides. Mating-out assays performed as described previously (14) allowed us to obtain an *E. coli* transconjugant expressing NDM-1, exhibiting resistance to all β -lactams, although remaining susceptible to aztreonam and with reduced susceptibility to carbapenems (MICs of 3, 1, and 0.75 $\mu\text{g/ml}$ for imipenem, ertapenem, and meropenem, respectively), as well as to all sulfonamides and all aminoglycosides. This transconjugant harbored a single 120-kb plasmid that was of the IncA/C type, as identified by PCR-based replicon typing (2), and that carried the $bla_{\text{CMY-6}}$ and *rmtC* genes in addition to $bla_{\text{NDM-1}}$. Interestingly, the same resistance determinants had been identified on an IncA/C type and 120-kb plasmid from *K. pneumoniae* in Kenya (14), suggesting that both plasmids could be related.

Multilocus sequence typing was performed as described previously (4), and the results were analyzed by eBURST (<http://pubmlst.org>).

The results showed that isolate CL belonged to the ST231 sequence type that corresponds to the ST of one NDM-1-positive *K. pneumoniae* isolate recently identified from India (7), but not to that of the NDM-1-producing *K. pneumoniae* isolates from Kenya (14). Nevertheless, it does not correspond to the most common STs identified from NDM-1-positive *K. pneumoniae*, which are ST14 and ST147 (7, 11, 13). It may be speculated that isolate CL would have a link with India, considering the geographical and cultural links between the two countries, the Indian diaspora being quite numerous in Mauritius. Corresponding medical authorities in Mauritius therefore have to be alerted about the threat of such multidrug-resistant strains and should implement adequate measures in order to control their spread. This study further underlines the occurrence of NDM-1 producers in countries from the African continent, after the recent identifications made in Kenya (14), Egypt (5), and Morocco (12).

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