Use of ChromID Extended-Spectrum β-Lactamase Medium for Detecting Carbenapenemase-Producing Enterobacteriaceae

Amélie Carrér, Nicolas Fortineau, and Patrice Nordmann*

Service de Bactériologie-Virologie, INSERM U914 Emerging Resistance to Antibiotics, Hôpital de Bicêtre, Assistance Publique/Hôpitaux de Paris, Faculté de Médecine Paris Sud, K-Bicêtre, France

Received 20 November 2009/Returned for modification 12 January 2010/Accepted 5 March 2010

ChromID extended-spectrum β-lactamase (ESBL) culture medium is routinely used for screening ESBL producers. This medium was tested for detecting carbapenemase-producing Enterobacteriaceae isolates from a collection of reference strains and compared to the CHROMagar KPC culture medium previously evaluated for detecting KPC-producing isolates. Producers of IMP-, VIM-, and KPC-type carbapenemases with high levels of resistance to cephalosporins and to carbapenems were detected at $1 \times 10^7$ CFU/ml. The OXA-48 producers were not detected on ChromID ESBL medium unless coexpressing ESBLs, whereas carbapenemase-producing isolates with MICs of $<4 \mu g/ml$ were not detected on CHROMagar KPC medium.

Carbapenemase-producing Enterobacteriaceae isolates have been increasingly identified worldwide (8, 9, 11). Ambler class B (VIM and IMP), class A (KPC), and class D (OXA-48) carbapenemase-producing isolates have been involved in nosocomial outbreaks (2, 5, 7, 10). In addition carbapenemase producers are usually multidrug resistant. Therefore, an early recognition of carbapenemase producers is critical to prevent their spread. However, the level of reduced susceptibility to carbapenems may vary significantly among carbapenemase producers, making their detection difficult (1, 4).

Several techniques have been tested for screening endemic KPC producers, including a novel carbapenem-containing medium, CHROMagar KPC (CHROMagar Company, Paris, France) (6, 13).

Resistance to expanded-spectrum cephalosporins is also commonly observed for KPC/VIM/IMP producers. Since screening media are used widely for detecting extended-spectrum β-lactamase (ESBL) producers, we have evaluated the ChromID ESBL screening medium, a commercially available chromogenic medium containing cepfodoxime (bioMerieux, La Balme-les-Grottes, France), for detecting carbapenemase producers (12), compared to the CHROMagar KPC medium used for screening KPC producers (13).

Twenty-eight carbapenemase-producing isolates belonging to various enterobacterial species of our own strain collection and of worldwide origin were included in the study. Strains had been characterized for β-lactamate content at the molecular level. The strains were as follows: KPC producers ($n = 10$), VIM/IMP producers ($n = 8$), and OXA-48 producers ($n = 10$). ESBLs were associated with carbapenemases for 14 isolates (Table 1). Using an inoculum of $\sim 2 \times 10^7$ CFU/ml (range, $1.5 \times 10^7$ to $3.5 \times 10^8$ CFU/ml), serial 10-fold dilutions of the 28 isolates were made in normal saline and 100 μl was plated onto tryptic soy agar (TSA), ChromID ESBL medium, and CHROMagar KPC medium. Viable bacteria were counted after 24 h and 48 h of culture at $37^\circ C$, and growth on selective media was compared to growth on standard TSA culture medium.

The lowest limit of detection of VIM, IMP, and KPC producers was $1 \times 10^7$ to $8 \times 10^7$ CFU/ml for ChromID ESBL (Table 1). Similar results were obtained for OXA-48 producers when an ESBL was associated (Table 1). Detection of OXA-48 producers without coexpression of an ESBL failed on ChromID ESBL culture medium (Table 1). Similar results were obtained after 48 h. For CHROMagar KPC, the lowest limit of detection of VIM, IMP, KPC, and OXA-48 producers ranged between $1 \times 10^1$ and $2 \times 10^7$ CFU/ml. Heterogeneity of detection in CHROMagar KPC can be explained by the wide range of MICs of carbapenems (from 0.5 to $>32 \mu g/ml$ for imipenem, ertapenem, and meropenem). When MICs are below 4 μg/ml, the limit of detection is raised significantly (Table 1). In addition, very weak detection was obtained for the OXA-48-producing Citrobacter freundii with the CHROMagar KPC medium despite high MICs of carbapenems.

ChromID ESBL medium is efficient for detection of producers of IMP/VIM and KPC-type carbapenemases based on the hydrolysis property of those enzymes toward expanded-spectrum cephalosporins. It failed to detect OXA-48 producers that do not express ESBLs, being observed in clinical isolates (3). CHROMagar KPC medium is a powerful medium for detecting isolates with high levels of resistance to carbapenems ($>16 \mu g/ml$), as shown in the study by Samra et al. (13), but is less sensitive for detecting isolates with low levels of resistance to carbapenems. Since carbapenemases are mostly of the IMP/VIM and KPC types in clinical isolates, screening media for ESBL producers may be an important help for detecting hospital acquisition of the very first cases of carriage of carbapenemase producers before clinical infections are evidenced. This detection strategy may help to prevent the emergence of clinically significant outbreaks with carbapenemase producers. However, detection of OXA-48 remains a problem to be solved. This could be more relevant in countries with high rates of these isolates.
This work was funded by grants from the INSERM (U914); the Ministère de l’Éducation Nationale et de la Recherche (UPRES-EA3539); Université Paris Xi, Paris, France; and the European Community (LSHM-CT-2005-018705).

REFERENCES


