

## Abstract

**Objective:** CEM-101 is a new fluoroketolide that has potent activity against respiratory tract pathogens. The activity against a variety of *Legionella pneumophila* serogroup was investigated.

**Methods:** The *in vitro* activity of CEM-101 was compared with that of telithromycin, azithromycin, erythromycin, levofloxacin and doxycycline against a total of 300 *Legionella pneumophila* by a standard agar dilution procedure using buffered yeast extract agar. The species tested included *L. pneumophila* serogroup 1 (125 isolates), serogroup 2 (28), 3 (25), 4 (36), 5 (25), 6 (50) and serogroup 7,8,9,12 (11).

**Results:** CEM-101 (MIC<sub>90</sub> 0.016 mg/L) was as active as levofloxacin (MIC<sub>90</sub> 0.016 mg/L) against *L. pneumophila* and was more active than telithromycin (MIC<sub>90</sub> 0.06 mg/L), azithromycin (MIC<sub>90</sub> 0.25 mg/L), erythromycin (MIC<sub>90</sub> 1 mg/L) and doxycycline (MIC<sub>90</sub> 1 mg/L). Against the most frequent *L. pneumophila* such as serogroup 1, the MIC<sub>90</sub> of CEM-101 (0.03 mg/L) was superior to telithromycin (0.06 mg/L), azithromycin (0.5 mg/L), erythromycin (1 mg/L) and doxycycline (1 mg/L). Against *L. pneumophila* serogroup 1, the MIC<sub>90</sub> of CEM-101 (0.03 mg/L) was similar to levofloxacin (0.016 mg/L). CEM-101 was less active against *L. pneumophila* serogroup 1, 2, 3, 4, 5, and 6 strains (MIC<sub>90</sub> 0.016 mg/L) than *L. pneumophila* serogroup 7, 8, 9 and 12 (MIC<sub>90</sub> 0.008 mg/L).

**Conclusions:** These data confirm the interesting activity of this new fluoroketolide CEM-101 against *Legionella pneumophila*.

## Introduction

CEM-101 is a novel fluoroketolide antibacterial agent related to 14-membered ring macrolides. CEM-101 appears to exhibit superior ability to bind to the ribosomes dimethylated at A2058 by the action of *erm* methyltransferase.

In susceptibility studies, CEM-101 is appreciably more potent than most macrolides or azalides against many Gram-positive organisms, including resistant *Streptococcus pneumoniae*, *Streptococcus pyogenes* and *Staphylococcus* spp. It has potent activity against various atypical respiratory pathogens like *Legionella pneumophila*, *Mycoplasma* spp. and *Chlamydia* spp.

## Objective

We determined the minimum inhibitory concentration (MIC) of CEM-101, telithromycin, azithromycin, erythromycin, doxycycline and levofloxacin against a variety of *Legionella pneumophila* isolated from nosocomial or acquired respiratory tract infections.

## Materials and Methods

## Strains

A variety of *Legionella pneumophila* were collected from mostly respiratory tract sources from 1988 to present. Multiple cultures from the same patient or source were excluded unless a change in organism or antibiogram was noted. Organisms were identified by standard methods such as described by Murray et al. (1).

Microorganisms                      Maximum Number of tested strains

1. <i>L. pneumophila</i> All serogroup	300
2. <i>L. pneumophila</i> serogroup 1	125
3. <i>L. pneumophila</i> serogroup 2	28
4. <i>L. pneumophila</i> serogroup 3	25
5. <i>L. pneumophila</i> serogroup 4	36
6. <i>L. pneumophila</i> serogroup 5	25
7. <i>L. pneumophila</i> serogroup 6	50
8. <i>L. pneumophila</i> serogroup 7,8,9, 12	11

## Determination of MICs

MICs were determined using the CLSI agar dilution method (2, 3), with replicate plating of the organisms onto a series of agar plates of increasing concentrations from 0.004 mg/L to 64 mg/L. Buffered Yeast extract (BYE) was used as the medium against *Legionella* strains. *Staphylococcus aureus* ATCC25923, *Pseudomonas aeruginosa* ATCC27853 and *Legionella pneumophila* ATCC33152 have been included as controls.

## Results

TABLE 1. Susceptibility of *Legionella pneumophila*

Organism (no. tested)	Antibiotic	MIC (mg/L)		
		Range	50%	90%
<i>L.pneumophila</i> All serogroup (300)	CEM-101	<0.004-0.06	0.008	0.016
	Telithromycin	0.016-0.12	0.03	0.06
	Azithromycin	0.008-1	0.06	0.25
	Erythromycin	0.008-2	0.25	1
	Levofloxacin	<0.004-0.03	0.008	0.016
	Doxycycline	0.5-1	1	1
<i>L.pneumophila</i> serogroup 1 (125)	CEM-101	<0.004-0.06	0.016	0.03
	Telithromycin	0.016-0.12	0.03	0.06
	Azithromycin	0.016-1	0.12	0.5
	Erythromycin	0.06-2	0.25	1
	Levofloxacin	<0.004-0.03	0.016	0.016
	Doxycycline	0.5-1	1	1
<i>L.pneumophila</i> serogroup 2 (28)	CEM-101	<0.004-0.03	0.008	0.016
	Telithromycin	0.016-0.06	0.016	0.03
	Azithromycin	0.008-0.12	0.06	0.12
	Erythromycin	0.008-0.5	0.25	0.25
	Levofloxacin	<0.004-0.016	0.008	0.008
	Doxycycline	0.5-1	1	1
<i>L.pneumophila</i> serogroup 3 (25)	CEM-101	<0.004-0.016	0.008	0.016
	Telithromycin	0.016-0.06	0.03	0.03
	Azithromycin	0.016-0.25	0.12	0.25
	Erythromycin	0.12-0.5	0.25	0.5
	Levofloxacin	<0.004-0.016	0.008	0.008
	Doxycycline	0.5-1	1	1

## Results continued

TABLE 2. Susceptibility of *Legionella pneumophila* serogroup 4, 5, 6 and others serogroup (7, 8, 9 and 12)

Organism (no. tested)	Antibiotic	MIC (mg/L)		
		Range	50%	90%
<i>L.pneumophila</i> serogroup 4 (36)	CEM-101	<0.004-0.03	0.008	0.016
	Telithromycin	0.016-0.06	0.03	0.03
	Azithromycin	0.016-0.25	0.12	0.12
	Erythromycin	0.06-0.5	0.5	0.5
	Levofloxacin	<0.004-0.016	0.016	0.016
	Doxycycline	0.5-1	1	1
<i>L.pneumophila</i> serogroup 5 (25)	CEM-101	<0.004-0.03	0.008	0.016
	Telithromycin	0.03-0.06	0.06	0.06
	Azithromycin	0.008-0.5	0.03	0.5
	Erythromycin	0.06-1	0.25	0.5
	Levofloxacin	<0.004-0.016	0.008	0.016
	Doxycycline	0.5-1	1	1
<i>L.pneumophila</i> serogroup 6 (50)	CEM-101	<0.004-0.03	0.008	0.016
	Telithromycin	0.016-0.06	0.016	0.03
	Azithromycin	0.03-0.25	0.06	0.12
	Erythromycin	0.008-0.25	0.12	0.25
	Levofloxacin	<0.008-0.016	0.008	0.016
	Doxycycline	0.5-1	1	1
<i>L.pneumophila</i> serogroup 7,8,9, 12 (11)	CEM-101	<0.004-0.008	0.008	0.008
	Telithromycin	0.016-0.06	0.03	0.06
	Azithromycin	0.06	0.06	0.06
	Erythromycin	0.12-0.5	0.25	0.5
	Levofloxacin	0.008-0.016	0.016	0.016
	Doxycycline	0.5-1	1	1

## Discussion

- CEM-101 (MIC<sub>90</sub> 0.016 mg/L) was significantly more potent than the most commonly used drugs for the treatment of Legionellosis, such as erythromycin and azithromycin.
- Among the antimicrobial agents tested, levofloxacin (MIC<sub>90</sub> 0.016 mg/L) was the only antimicrobial agent that was comparable to CEM-101 against *Legionella pneumophila*.
- Against *L. pneumophila*, CEM-101 (MIC<sub>90</sub> 0.016 mg/L) was significantly more active than erythromycin (MIC<sub>90</sub> 1 mg/L), azithromycin (MIC<sub>90</sub> 0.25 mg/L) and doxycycline (MIC<sub>90</sub> 1 mg/L) and slightly more active than telithromycin (MIC<sub>90</sub> 0.06 mg/L).
- *L. pneumophila* serogroup 1 was more resistant to CEM-101 (MIC<sub>90</sub> 0.3 mg/L) than other *L. pneumophila* serogroup.
- The activity of CEM-101 against *L. pneumophila* serogroup 1 was particularly interesting, in that this serogroup is the most resistant strain to erythromycin (MIC<sub>90</sub> 1 mg/L) and the most common strain isolated from nosocomial or acquired respiratory tract infections.
- Against *L. pneumophila* serogroup 5, azithromycin and erythromycin were less active (MIC<sub>90</sub> 0.5 mg/L) than other ketolide tested: CEM-101 (MIC<sub>90</sub> 0.016 mg/L) and telithromycin (MIC<sub>90</sub> 0.06 mg/L).
- *L. pneumophila* serogroup 7,8,9 and 12 were the most *L. pneumophila* serogroup susceptible to CEM-101 (MIC<sub>90</sub> 0.008 mg/L).

## Conclusion

- CEM-101 should be a promising agent for the treatment of lower respiratory tract infections caused by *Legionella pneumophila*.
- Clinical studies should undertaken to evaluate the *in vivo* effectiveness of this new antimicrobial agent.

## References

1. Murray et al., Manual of Clinical Microbiology, 9rd ed., 2007, A.S.M. Chap. 53; 835-849.
2. Performance standards for antimicrobial susceptibility testing; 18th Informational Supplement; M100-S18, Clinical and Laboratory Standards Institute (CLSI), Wayne, PA, January 2008)
3. Method for dilution antimicrobial susceptibility tests for bacteria that grow aerobically; approved standard 17th edition, M7-A7, Clinical and Laboratory Standards Institute (CLSI), Wayne, PA, 2006)