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# Isolation of an SHV-12 β-Lactamase-Producing *Escherichia coli* Strain from a Dog with Recurrent Urinary Tract Infections

An *Escherichia coli* strain (EC98/4153-2) was isolated in 1998 (by the Microbiology and Parasitology Service, Complutense University, Veterinary Hospital, Madrid, Spain) from a urine specimen from a dog with a recurrent urinary tract infection, and this strain was submitted to the Network of Veterinary Antimicrobial Resistance Surveillance (VAV). This strain showed resistance (8) to amoxicillin, cephalothin, cefotaxime, ceftazidime, and aztreonam, but it was susceptible to cefoxitin, imipenem, and amoxicillin-clavulanic acid (Table 1). The same resistance phenotype was detected by the disk diffusion method. Extended-spectrum β-lactamase (ESBL) production was detected in this strain by double-disk synergy tests (with cefotaxime, amoxicillin-clavulanic acid, and ceftazidime disks) (3).

In order to characterize the β-lactamase synthesized by *E. coli* 4153-2, $bla_{SHV}$ and $bla_{TEM}$ genes were PCR amplified using specific primers and conditions as previously described (11). TEM β-lactamase PCR amplification was negative, while a positive amplicon was obtained for SHV β-lactamase; this SHV PCR product was purified, and both strands were automatically sequenced (ABI prism 310; Perkin-Elmer). The deduced amino acid sequence of the SHV amplicon corresponded to the SHV-12 type β-lactamase, previously described (9). This SHV-12 β-lactamase is characterized by three point mutations in the SHV-1 precursor (Gln35, Ser238, and Lys240), according to Ambler nomenclature (1).

SHV-12 β-lactamase was first described in 1997 for *E. coli* and *Klebsiella pneumoniae* isolates of human clinical origin in Switzerland (9). Then, it was also detected in human clinical isolates of *K. pneumoniae*, *E. coli*, and *Enterobacter cloacae* in Korea, Taiwan, and Italy (3–6, 10, 12). To our knowledge, this is the first report of an SHV-12-producing member of *Enterobacteriaceae* of animal origin. Bradford et al. (2) characterized expanded-spectrum cephalosporin resistance in *E. coli* isolates obtained from sick animals; overexpression of AmpC β-lactamase in addition to TEM-type enzymes was the probable mechanism of resistance in these strains. In general, there are very few data about expanded-spectrum cephalosporin resistance in *E. coli* of animal origin. This could be due to the fact that veterinary routine antimicrobial testing does not include those compounds. Indeed, the antimicrobial panels employed by VAV are pioneering the testing of antimicrobials in animals (7).

TABLE 1. Antimicrobial susceptibilities of *E. coli* EC98/4153-2

| Antimicrobial | MIC (μg/ml) | IZD[a] (mm) |
|---|---|---|
| Amoxicillin | >256 | 6[c] |
| Amoxicillin-clavulanic acid | ND[b] | 20 |
| Cephalothin | >256 | 6 |
| Cefoxitin | 4 | 24 |
| Cefotaxime | 64 | 19 |
| Ceftazidime | >64 | 13 |
| Aztreonam | >32 | 13 |
| Imipenem | 0.06 | 28 |
| Nalidixic acid | >256 | 6 |
| Ciprofloxacin | 8 | 11 |
| Tetracycline | >256 | 6 |
| Chloramphenicol | 64 | 8 |
| Trimethoprim | >256 | 6 |
| Sulfonamides | >512 | 6 |
| Gentamicin | 0.5 | 19 |
| Neomycin | 64 | 10 |
| Amikacin | 4 | 19 |
| Apramycin | 4 | 13 |
| Streptomycin | ND | 6 |

[a] IZD, inhibition zone diameter, determined by the disk diffusion test.
[b] ND, not done.
[c] No inhibition (diameter of the disk).

It has been shown that disk diffusion methods are not sufficiently sensitive for detection of SHV ESBL-producing isolates (9). Nevertheless, the criteria mentioned by Nüesch-Inderbinen et al. (9)—inhibitory zone diameters of <21 mm for cefotaxime and <16 mm for ceftazidime—would be sufficient for detecting this strain, since it shows values of 19 and 13 mm, respectively. Other strains fulfilling these criteria are being analyzed by VAV.

Several questions arise from this finding, especially those related to the origin of this strain. The clinical history of the dog indicated that it had had recurrent urinary tract infections since 1992 and that it had received different antibiotic treatments over the years, such as cephalexin (in 1992); furantoin (in 1994); ampicillin, amoxicillin-clavulanic acid, and trimethoprim-sulfonamides (in 1995 and 1996); and amoxicillin-clavulanic acid and furantoin (in 1998). Treatment with expanded-spectrum cephalosporins is not recorded in the dog's clinical history, although the possibility that the dog had been also treated by other clinicians cannot be excluded. Besides, this strain was also resistant to other antimicrobials, such as nalidixic acid, ciprofloxacin, chloramphenicol, tetracycline, trimethoprim, and sulfonamides (Table 1), and cross-selection by any of these antimicrobials cannot be excluded. Interestingly, a new urine sample from the dog was analyzed 1 year later, and the new *E. coli* strain isolated showed a different antimicrobial susceptibility profile, suggesting that the original SHV-12-producing strain was not able to persist in the animal's body.

This finding is proof of the need to coordinate surveillance of antimicrobial resistance among humans and animals and shows that a putative reservoir of unknown origin (human or animal) could be present in pet animals, which are in close contact with humans.

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