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Brief report

Bacterial contamination of propofol vials used in operating rooms of a third-level hospital

Andrés Zorrilla-Vaca [a,*,†], Kevin Escandón-Vargas MD [a], Vanessa Brand-Giraldo [a], Tatiana León MD [b], Mónica Herrera MD [b], Andrey Payán PhD [c]

[a] School of Medicine, Faculty of Health, Universidad del Valle, Cali, Colombia
[b] Department of Anesthesiology, Hospital Universitario del Valle, Universidad del Valle, Cali, Colombia
[c] School of Bacteriology and Clinic Laboratory, Faculty of Health, Universidad del Valle, Cali, Colombia

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We found a 6.1% bacterial contamination rate among 198 propofol vials collected after clinical use in 12 operating rooms of a high-complexity hospital in Cali, Colombia. Some propofol vials were used for extended periods (up to 72 hours), and only 26.1% of vials were punctured once. Median time of use, although not statistically significant, was higher in positive samples (7.2 vs 3.5 hours, $P = .08$). Education on the topic should stress that vials are single-patient use and must be immediately discarded after use.

Propofol is an intravenous anesthetic with a recognized property of supporting microbial growth linked to its lipid base. Microbiologic contamination of propofol lipid emulsions may occur from the environment either during manufacture (intrinsic) or after vial opening (extrinsic), the latter of which is the most frequent.[1,2] It has even led to outbreaks of postsurgical infections and sepsis in the United States and other developed countries.[2-6] However, this topic is poorly studied in developing countries, and specifically in Colombia, there are no studies documenting propofol contamination or assessing whether it has clinical significance or not.

Therefore, we performed a study to determine the frequency of bacterial contamination of propofol vials used in operating rooms (ORs) of a high-complexity hospital in Cali, Colombia.

METHODS

The Hospital Universitario del Valle is a 700-bed third-level public hospital in Cali, Colombia, which has 18 ORs. Propofol used in this setting is from a generic manufacturer and comes in 20-mL vials with 1% propofol preservative-free lipid emulsion. We carried out an observational study from September 1-November 20, 2014, in the 12 general ORs of the Hospital Universitario del Valle. Auxiliary personnel of the ORs labeled propofol vials with the date and time of opening and discard and the number of extraction punctures made. All available discarded propofol vials used in surgical procedures were included in the study unless completely unlabeled. Time between opening and discard of each vial was regarded as time of use. The Institutional Ethics Committee of the Universidad del Valle approved this study. The medical and nursing staff present during surgeries were unaware of the study's aim to avoid possible influences on aseptic practice. Auxiliary personnel in the ORs daily collected propofol vials after the vials were discarded and kept them cold at 4°C until a researcher took them to the laboratory.

Two aliquots were aseptically drawn up from each vial and were inoculated separately: an aliquot of 1-1,000 μL into a thioglycollate broth (BD Diagnostics, Sparks, MD) and an aliquot of 1-100 μL on a trypticase soy agar supplemented with 5% sheep blood. The sample amounts depended on the remaining volume. Plates were examined for bacterial growth, and CFU/mL concentrations were determined by the standard plate count method after overnight incubation at 35°C ± 2°C. A single researcher performed the counts. Thioglycollate broths allowed longer incubation periods for recovering bacteria with very low colony counts and slow-growing organisms. These broths were subcultured at 3, 10, and 15 days. BBL Crystal Identification Systems (BD Diagnostics, Sparks, MD) were used for bacterial identification through dehydrated enzymatic and biochemical substrata in panels. If we could not identify microorganisms through this method, we used standard biochemical tests. The reference strains *Staphylococcus aureus* ATCC 25213, *Escherichia coli* ATCC 25922, and *Pseudomonas aeruginosa* ATCC 27853

* Address correspondence to Andrés Zorrilla-Vaca, School of Medicine, Faculty of Health, Universidad del Valle, Calle 4B # 36-00, 760043 Cali, Colombia.
E-mail address: andres.zorrilla@correounivalle.edu.co (A. Zorrilla-Vaca).
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† Current affiliation: Research trainee, Department of Anesthesiology, Johns Hopkins University, Baltimore, MD, USA.

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(American Type Culture Collection, Manassas, VA) were prepared as controls for bacterial growth and reactivity. In addition, unused propofol vials were drawn up with sterile technique and subcultured to evaluate bacterial growth, therefore serving as negative controls. Data were entered and analyzed in Stata version 10 (Stata, College Station, TX). We used frequencies for categorical variables and measures of central tendency and dispersion for quantitative variables. To assess statistically significant differences, comparisons were performed between the study variables and bacterial growth using the appropriate tests. *P* values <.05 were considered significant.

RESULTS

A total of 200 used propofol vials were collected, of which 198 met selection criteria and were included in the study. Median time of use was 3.7 hours, ranging from 6 minutes to 72.4 hours (Table 1). Only 26.3% of vials were punctured just once (range of extraction punctures, 1-4). There were 2 different propofol lots; almost two-thirds of vials belonged to one of them. Agar culture was positive in 104 (52.5%) vials, whereas thioglycollate broth culture was positive in 12 of them (overall contamination of 6.1%). The most frequent microorganisms isolated were *Corynebacterium* spp (n = 3, 25%) and *S epidermidis* (n = 3, 25%). Median colony forming unit CFU count ranged between 10 and 2,000 CFU/mL; higher values were found in *S epidermidis* isolates.

Most variables were comparable among both groups of vials with positive and negative bacterial growth (Table 2). Median time of use was higher for the positive vials but this comparison was not statistically significant (7.2 vs 3.5 hours, *P* = .08). The propofol lot, number of extraction punctures, residual propofol volume, and volumes cultured in agar and broth were not related to bacterial growth in the propofol vials.

DISCUSSION

To our knowledge, this is the first study of its kind in Colombia. We found 12 out of 198 propofol vials with bacterial growth identifiable through thioglycollate broths and blood agar plates, accounting for a bacterial contamination rate of 6.1%. This finding is consistent with other studies performed in ampoules collected from ORs, which have reported rates from 3%-6.3%.[7,8] Of note, these studies and others that have assessed propofol contamination in syringes, infusion systems, and intravenous stopcock dead spaces were conducted in developed countries. All microorganisms isolated in our study were gram-positive bacteria; however, literature has demonstrated that propofol is an excellent culture medium for the growth of gram-positive and gram-negative organisms and yeasts.[1,9] *S epidermidis*, *Corynebacterium* sp, *Bacillus* sp, *Micrococcus* sp, and *P aeruginosa* have been reported as contaminating agents of propofol ampoules after clinical use.[7,8] Our study constitutes the first report of *Enterococcus faecalis* and several coagulase-negative staphylococci other than *S epidermidis*.

We found that the time of use of the vials was as high as 72.4 hours and that almost 75% of the vials were punctured more than once, meaning strict aseptic recommendations are not followed.[3,10] Median time of use, although not statistically significant, was higher in positive samples (7.2 vs 3.5 hours, *P* = .08). McHugh and Roper performed a similar study with ampoules and did not find association between delays in administration and bacterial growth.[7] Interestingly, another study reported that all the contaminated ampoules had been used in multiple patients, but the authors did not perform statistical comparison between groups.[8]

The main limitation of our study was that its design did not allowed fully reliable comparisons between samples with and without bacterial growth; however, we only explored possible factors related to the outcome.

Table 1
Characteristics of the propofol samples from single vials (N = 198)

Variable	Value
Time of use (h)*	3.7 (0.1-72.4)
Residual propofol volume (mL)	1.0 (0.1-15.0)
No. of extraction punctures	2 (1-4)
Vials punctured once	52 (26.3)
Vials punctured more than once	146 (73.7)
Propofol lot	
A	69 (34.9)
B	129 (65.1)
Bacterial growth	
Yes	12 (6.1)
No	186 (93.9)
Bacterial isolate	
Corynebacterium spp	3 (25)
Staphylococcus epidermidis	3 (25)
S cohnii sbsp *cohnii*	1 (8.3)
S haemolyticus	1 (8.3)
S saprophyticus	1 (8.3)
S xylosus	1 (8.3)
Bacillus sphaericus	1 (8.3)
Enterococcus faecalis	1 (8.3)

NOTE. Variables are median (range) or n (%).
*This variable could only be estimated in 164 vials.

Table 2
Comparison of vial characteristics regarding bacterial growth in propofol vials (N = 198)

	Bacterial growth		
Variable	Yes (n = 12)	No (n = 186)	*P* value
Time of use (h)	7.2 (1.0-47.3)*	3.5 (0.1-72.4)†	.08‡
Residual propofol volume (mL)	1.3 (0.5-10.0)	1.0 (0.1-15.0)	.25‡
No. of extraction punctures, mean ± SD	2.0 ± 0.95	2.1 ± 0.84	.76§
Propofol lot			.22‖
A	2 (16.7)	67 (36.0)	
B	10 (83.3)	119 (64.0)	
Propofol volume cultured in agar (μL)	100 (1-100)	100 (1-100)	.70‡
Propofol volume cultured in thioglycollate broth (μL)	725 (50-1,000)	200 (1-1,000)	.24‡

NOTE. Variables are median (range), n (%), or as otherwise indicated.
*There were 11 vials in this group.
†There were 153 vials in this group.
‡Mann-Whitney *U* test.
§Student *t* test.
‖Fisher exact test.

In conclusion, bacterial contamination occurred in 6.1% of propofol vials, which is similar to studies elsewhere. We also found that some vials were used for extended periods and that approximately 75% of vials were punctured more than once. Education on the topic should stress that vials are single-patient use and must be immediately discarded after use.[10] Clinical significance of bacterial contamination of propofol vials in our setting should be determined in further epidemiologic studies.

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