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CASE STUDY

# Unexplained increases in serum vancomycin concentration in a morbidly obese patient

Sean P. Kane[a,b,*], Scott D. Hanes[a]

[a] *Department of Pharmacy Practice, College of Pharmacy at Rosalind Franklin University of Medicine and Science, North Chicago, IL, United States*
[b] *Critical Care Clinical Pharmacist, Advocate Condell Medical Center, Libertyville, IL, United States*

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**KEYWORDS**
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**Summary**
*Introduction:* To report a case of increases in vancomycin concentrations without additional vancomycin doses being given.
*Case study:* A 64 year-old morbidly obese female received three total doses of vancomycin for surgical prophylaxis and for ventilator-associated pneumonia. Subsequent vancomycin concentrations from the patient's central venous catheter (CVC) demonstrated increasing drug levels from 27.1 to 45.9 mcg/mL despite no additional vancomycin being given and proper line flushing prior to sample collection. There is no clear explanation for the increase in the patient's vancomycin concentration. Drug leaching from the CVC, enterohepatic recycling, drug redistribution from adipose or other tissues, and assay cross-reactivity with other medications are all potential explanations for the increased vancomycin concentrations.
*Conclusion:* This case report describes an unexplained increase in vancomycin concentrations and reinforces both the fallibility of laboratory testing and that unusual circumstances do occur. Several potential causes are hypothesised with CVC drug leaching being the most likely. Nurses and other healthcare providers with similar scenarios should consider a peripheral blood sample to rule out the potential for CVC drug leaching as a possible explanation.


* Corresponding author at: 3333 Green Bay Road, North Chicago, IL 60064, United States. Fax: +1 847 775 6593.
*E-mail addresses:* sean.kane@rosalindfranklin.edu (S.P. Kane), scott.hanes@rosalindfranklin.edu (S.D. Hanes).

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**Implications for clinical practice**

- Vancomycin is an antibiotic with a narrow therapeutic window that requires therapeutic drug monitoring with drug levels to ensure safety and efficacy.
- Vancomycin has been shown to leach from central venous catheters (CVCs) which can produce invalid drug levels if a blood sample is collected from a CVC.
- Nurses and other healthcare providers with puzzling vancomycin drug levels from a CVC should consider resampling from a peripheral site to rule-out the possibility of CVC drug leaching.

## Introduction

Vancomycin remains one of the most commonly utilised antibiotics in the treatment of gram-positive bacterial infections. Vancomycin is also one of the most investigated antibiotics with regards to pharmacokinetics/pharmacodynamics and therapeutic drug monitoring. In 2009, guidelines for therapeutic monitoring of vancomycin were jointly published by the American Society of Health-System Pharmacists, the Infectious Disease Society of America, and the Society of Infectious Disease Pharmacists (Rybak et al., 2009). We report a case of increasing vancomycin concentrations due to suspected vancomycin leaching from a central venous catheter (CVC).

## Case study

A 64 year-old Caucasian female patient was admitted to the intensive care unit for increasing shortness of breath due to diastolic heart failure and worsening of chronic respiratory failure. The patient's past medical history was significant for type-II diabetes mellitus, hypertension, hyperlipidaemia, extreme obesity (168 kg and BMI of 66 $kg/m^2$), obstructive sleep apnoea, asthma and chronic respiratory failure.

The patient was briefly admitted to the intensive care unit on hospital days one and two, but her respiratory status improved with diuresis and noninvasive positive pressure ventilation. She was transferred out to a general medicine floor for further supportive care; however, on hospital day six, the patient became bradycardic progressing to a cardiac arrest. Advanced cardiovascular life support was initiated resulting in return of spontaneous circulation within five minutes. The patient was intubated and received therapeutic hypothermia. On hospital day 10, because the patient was unable to be weaned from mechanical ventilation, she underwent a tracheostomy and percutaneous endoscopic gastrostomy (PEG) tube placement. Perioperatively for the PEG placement, she received a 1000 mg dose of vancomycin for surgical prophylaxis.

In the postoperative setting on day 11, the patient became hypotensive and briefly required vasopressor support. An infectious workup indicated a possible urinary tract infection. Given the patient's antibiotic allergies including penicillins, cephalosporins and quinolones, empiric aztreonam and extended-interval tobramycin were initiated. Following a random tobramycin level of 6.8 mcg/mL drawn 8 hours after infusion, Q36hr tobramycin was initiated as per the Hartford nomogram (Nicolau et al., 1995).

On hospital day 14, a urine culture revealed *Pseudomonas aeruginosa* susceptible to aztreonam at which time tobramycin was discontinued after receiving two total doses; however, due to the concern for a new pneumonia, vancomycin was empirically added to aztreonam, and the patient received a 2000 mg and 1000 mg dose approximately three hours apart totaling 17 mg/kg of vancomycin. As a point of emphasis, this was the last dose of vancomycin the patient received. Due to concern regarding the patient's acute kidney injury (increasing serum creatinine up to 2 mg/dL from a baseline of 1 mg/dL; see Fig. 1), a random vancomycin level was drawn on hospital day 16 indicating a level of 27.2 mcg/mL (Dimension® VANC Flex® assay, Siemens Healthcare Diagnostics Inc., Tarrytown, NY 10591). A subsequent level of 27.1 mcg/mL on hospital day 17 indicated nearly no drug elimination. Paradoxically, a follow-up level on hospital day 18 indicated an increasing drug level of 31.7 mcg/mL. Finally, a fourth random drug level on hospital day 20 demonstrated an even higher random vancomycin level of 45.9 mcg/mL. Again, the patient did not receive any vancomycin after hospital day 14 (see Fig. 2).

Given the unexplained increase in vancomycin levels, a careful analysis of the patient's room, medication administration record, and operating room records was undertaken. As verified by communication with nursing staff, an analysis of the barcode medication administration record, and examination of the automated dispensing cabinet log, at no time was the patient given vancomycin after hospital day 14. All drug levels were drawn through a non-tunneled triple lumen internal jugular CVC. This line was used for medication administration throughout the patient's hospital stay and was flushed prior to all blood collections per institution policy.

Unfortunately, the patient's respiratory status and renal function began to dramatically decline on hospital day 19. By hospital day 22, the patient's plan of care was changed to comfort measures only and she expired a short time later.

## Discussion

There are a variety of potential explanations regarding this patient's curious increase in vancomycin concentration despite not receiving additional vancomycin doses. In our opinion, the more likely scenario is a falsely elevated assay result due to elevated drug concentrations at the site of the blood sample; however, this does not explain an increase in drug concentration with subsequent samples in the absence of additional vancomycin administration. Regardless of the aetiology, this case report reinforces the potential fallibility

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