

Cost and Length of Stay Associated with Vancomycin-Induced Nephrotoxicity

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Abstract

Objectives: Decreased susceptibility to vancomycin has led to recommendations for increased serum concentration targets for some infections, which has been shown to increase the risk of nephrotoxicity (NT) [1-3]. The objective of this study was to determine if vancomycin-induced nephrotoxicity has a significant impact on cost from the hospital perspective or on length of stay. **Methods:** A cost of illness study from the hospital perspective. We conducted a secondary analysis of a cohort of 398 randomly selected inpatients receiving vancomycin in a tertiary care hospital in Rochester, New York, USA. Total and variable costs were generated by hospital accountants using micro-costing methods. NT was defined as 0.5 or 50% or greater increase in serum creatinine from baseline. Generalized linear models with log link and gamma distribution and semi-log regression were used to model total and variable costs and length of stay, respectively. Cost estimates are reported in 2009 USD.

Results: 49 (12%) of patients had NT. The unadjusted median variable costs for patients with NT were higher than for patients without NT (\$47,511 vs. \$22,355, p<.0001). On multivariable analysis, variable costs were 17% greater for patients with NT compared to patients without, but this difference was not statistically significant. The median length of stay for patients with NT was two-fold greater than for patients without NT (22 vs. 11 days, unadjusted, p<.0001). After accounting for severity of illness and other factors, NT patients stayed on average 46% longer than non-nephrotoxic patients. **Conclusions:** Patients with NT have significantly increased length of stay relative to patients without NT. Further research is needed to confirm whether increased length of stay has a meaningful impact on costs. As vancomycin susceptibility continues to decrease, higher doses of vancomycin may lead to an increased incidence of NT and an increase in resource utilization among these patients.

Methods

Database Design

Secondary analysis of a retrospective cohort study of adult inpatients at University of Rochester Medical Center (URMC) from January 1, 2008 – December 31, 2009. Patients were eligible if:

- 18 or older on admission
- Non-neutropenic (Baseline ANC > 1000 cells/mm3)
- Received 2 or more days of IV vancomycin
- Baseline serum SCr <2.0 mg/dL

Patients were excluded if they had cystic fibrosis, did not have a serum V concentration drawn within 96 hours of V initiation, or had fewer than 2 SCr values drawn

Study Design and Definitions

- Cost of illness and length of stay (LOS) study from the hospital perspective.
- Total and variable costs generated by hospital accountants using micro-costing methods.
- Costs were adjusted to 2009 USD using the Personal Consumption Expenditures (PCE) Hospital and Nursing Home Services index

Analysis

- Baseline characteristics for patients with and without NT were compared
- Generalized linear models (GLM) with log link and gamma distribution were used to model total and variable costs as a function of NT
- Semi-log regression was applied to model LOS as a function of NT controlling for other covariates

Conclusions

- The median LOS for NT patients was twice that of non-NT patients
- Adjusted costs appeared to be greater in the NT group, but the difference was not significant

Limitations

- Differences in micro-costing methods across institutions may limit generalizability
- Relatively small sample size

References

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3. Patel N, Pai MP, Rodvold KA, Lomaestro B, Drusano GL, Lodise TP. Vancomycin: We Can't Get There from Here. *Clinical Infectious Diseases* **2011**; 52(8): 969-74.

Results

Table 1. Baseline Characteristics

| Variable | n (%) | NT (n=49) | No NT (n=349) | p |
|-------------------------------|-------|---------------|------------------|--------|
| Hospital Costs; Mean (SD) | | | | |
| <i>Total Costs (TC)</i> | | 74514 (73104) | 48837 (82659) | <.0001 |
| <i>Variable Costs (VC)</i> | | 45574 (44178) | 30129 (50737) | <.0001 |
| <i>Fixed Costs (FC)</i> | | 28940 (29966) | 18708 (32469) | <.0001 |
| Length of Stay; Mean (SD) | | 28 (20) | 20 (28) | <.0001 |
| Age; Mean (SD) | | 57 (57) | 58 (17) | <.0001 |
| Male | | 28 (57) | 204 (58) | 0.86 |
| Race | | | | |
| <i>Black</i> | | 8 (16) | 33 (10) | 0.06 |
| <i>White</i> | | 40 (82) | 276 (79) | |
| <i>Other</i> | | 1 (2) | 40 (11) | |
| NT Grade (N=49) | | | | |
| <i>Mild</i> | | 12 (24) | — | — |
| <i>Moderate</i> | | 25 (51) | — | |
| <i>Severe</i> | | 12 (25) | — | |
| <i>C. difficile</i> Infection | | 1 (2) | 13 (4) | 0.55 |
| Developed Need for Dialysis | | 12 (24) | 3 (1) | <.0001 |
| APACHE II Score; Mean (SD) | | 13 (6) | 11 (6) | 0.01 |
| CCI; Mean (SD) | | 3 (2) | 2 (2) | 0.02 |
| Any Major Procedure | | 22 (45) | 153 (44) | 0.89 |
| Any Minor Procedure | | 45 (92) | 300 (86) | 0.26 |
| Admitted to ICU | | 27 (55) | 150 (43) | 0.11 |
| Admission due to Infection | | 17 (35) | 162 (46) | 0.12 |
| Vancomycin Indication | | | | |
| <i>Blood Stream Infection</i> | | 6 (12) | 21 (6) | 0.26 |
| <i>Empiric</i> | | 34 (70) | 265 (76) | |
| <i>Other</i> | | 9 (18) | 63 (18) | |
| Died in Hospital | | 18 (37) | 35 (10) | <.0001 |

Figure 1. Mean and Median Total Hospital Costs and LOS for patients with and without NT

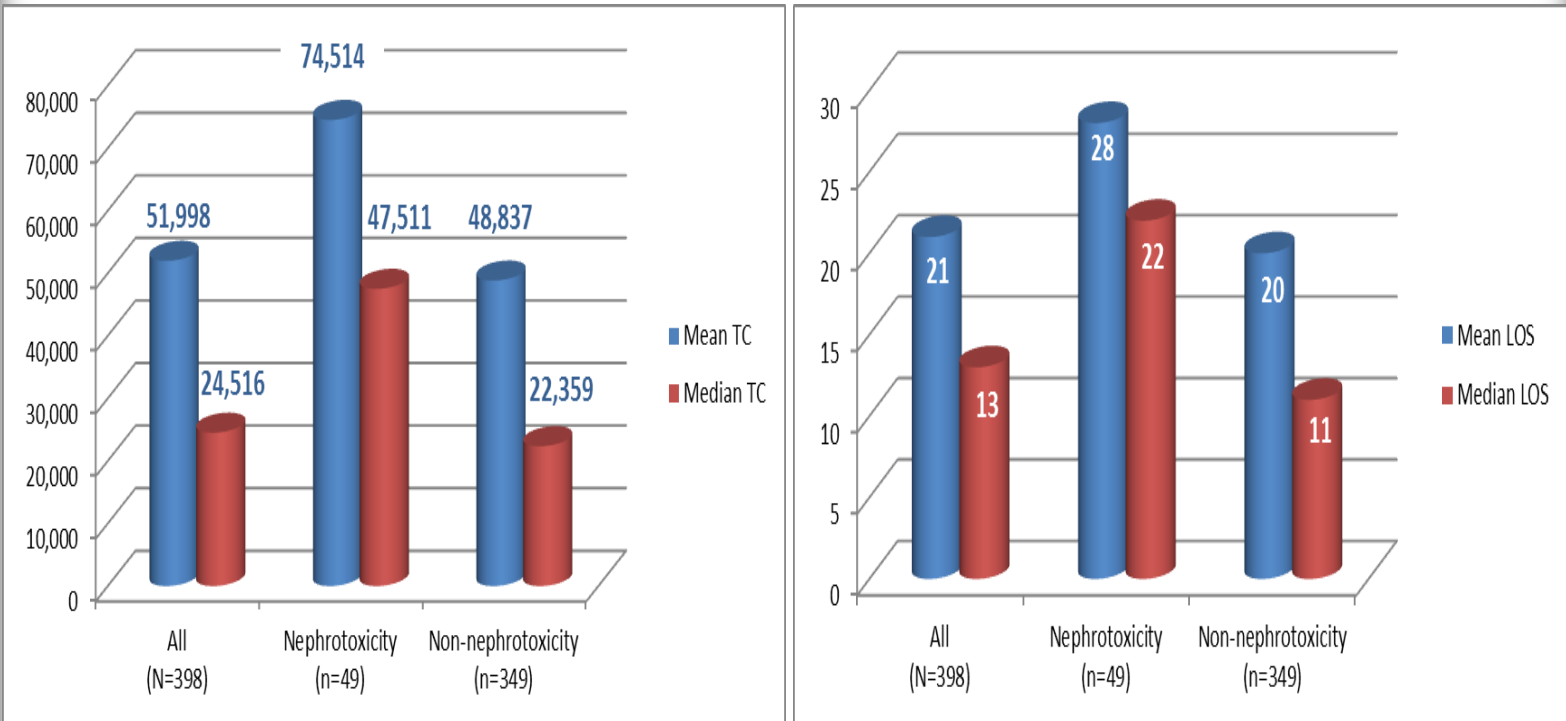


Table 2. Results from GLM cost model and Semi-log LOS regression (N=398)

| Variable | Total Hospital Costs^ | LOS# |
|-----------------------------|-----------------------|----------------------|
| Coeff (SE) | | |
| Nephrotoxicity | 0.17 (0.15) | 0.46* (0.11) |
| Died in Hospital | -0.42* (0.14) | -0.67* (0.11) |
| Developed Need for Dialysis | 0.66* (0.26) | 0.20 (0.20) |
| APACHE II Score | 0.04* (0.01) | 0.03* (0.01) |
| CCI | 0.06* (0.02) | 0.04* (0.02) |
| DRG Weight | 0.03* (0.01) | 0.03* (0.0) |
| Any major procedure | 0.61* (0.09) | 0.30* (0.07) |
| Any minor procedure | 0.96* (0.13) | 0.68* (0.10) |
| Admitted to ICU | 0.39* (0.10) | 0.11 (0.08) |
| Admission due to infection | -0.46* (0.09) | -0.32* (0.07) |
| Constant | 9.09* (0.30) | 1.47* (0.22) |

^ Generalized Linear Model

#Semi-log regression

* = p<.01

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