Med Intensiva. 2016;40(8):474–482

medicina intensiva

www.elsevier.es/medintensiva

ORIGINAL

Nosocomial pneumonia caused by methicillin-resistant *Staphylococcus aureus* treated with linezolid or vancomycin: A secondary economic analysis of resource use from a Spanish perspective

J. Rello[a,*], M. Nieto[b], J. Solé-Violán[c], Y. Wan[d], X. Gao[d], C.T. Solem[d], M. De Salas-Cansado[e], F. Mesa[e], C. Charbonneau[f], J. Chastre[g]

[a] *CIBERES, Universitat Autónoma de Barcelona, Spain*
[b] *Medicina Intensiva, Hospital Clínico Universitario de San Carlos, Madrid, Spain*
[c] *Medicina Intensiva, Hospital Universitario de Gran Canaria Dr. Negrín, Las Palmas de GC, Spain*
[d] *Pharmerit International, Bethesda, MA, United States*
[e] *Pfizer, Madrid, Spain*
[f] *Pfizer, Paris, France*
[g] *Service de Réanimation Médicale, Institut de Cardiologie, Groupe Hospitalier Pitié-Salpêtrière, Paris, France*

Received 28 September 2015; accepted 26 January 2016
Available online 6 April 2016

KEYWORDS
Methicillin-resistant *Staphylococcus aureus*;
Economics;
Renal failure;
Pneumonia;
Spain

Abstract
Objectives: Adopting a unique Spanish perspective, this study aims to assess healthcare resource utilization (HCRU) and the costs of treating nosocomial pneumonia (NP) produced by methicillin-resistant *Staphylococcus aureus* (MRSA) in hospitalized adults using linezolid or vancomycin. An evaluation is also made of the renal failure rate and related economic outcomes between study groups.
Design: An economic *post hoc* evaluation of a randomized, double-blind, multicenter phase 4 study was carried out.
Scope: Nosocomial pneumonia due to MRSA in hospitalized adults.
Participants: The modified intent to treat (mITT) population comprised 224 linezolid- and 224 vancomycin-treated patients.
Interventions: Costs and HCRU were evaluated between patients administered either linezolid or vancomycin, and between patients who developed renal failure and those who did not.
Primary endpoints: Analysis of HCRU outcomes and costs.
Results: Total costs were similar between the linezolid- (€17,782 ± €9,615) and vancomycin-treated patients (€17,423 ± €9,460) ($P = .69$). The renal failure rate was significantly lower in the linezolid-treated patients (4% vs. 15%; $P < .001$). The total costs tended to be

* Corresponding author.
E-mail address: jrello@crips.es (J. Rello).

higher in patients who developed renal failure (€19,626 ± €10,840 vs. €17,388 ± €9,369; *P* = .14). Among the patients who developed renal failure, HCRU (days on mechanical ventilation: 13.2 ± 10.7 vs. 7.6 ± 3.6 days; *P* = .21; ICU stay: 14.4 ± 10.5 vs. 9.9 ± 6.6 days; *P* = .30; hospital stay: 19.5 ± 9.5 vs. 16.1 ± 11.0 days; *P* = .26) and cost (€17,219 ± €8,792 vs. €20,263 ± €11,350; *P* = .51) tended to be lower in the linezolid- vs. vancomycin-treated patients. There were no statistically significant differences in costs per patient-day between cohorts after correcting for mortality (€1000 vs. €1,010; *P* = .98).
Conclusions: From a Spanish perspective, there were no statistically significant differences in total costs between the linezolid and vancomycin pneumonia cohorts. The drug cost corresponding to linezolid was partially offset by fewer renal failure adverse events.

PALABRAS CLAVE
Staphylococcus aureus resistente a meticilina;
Farmacoeconomía;
Insuficiencia renal;
Neumonía;
España

Neumonía nosocomial causada por *Staphylococcus aureus* resistente a meticilina tratada con linezolid o vancomicina: análisis económico secundario del uso de recursos sanitarios desde una perspectiva española

Resumen
Objetivos: Analizar la utilización de recursos sanitarios (URS) y los costes de la neumonía nosocomial por *Staphylococcus aureus* resistente a meticilina en adultos hospitalizados tratados con linezolid o vancomicina. También se evaluó el porcentaje de fallo renal entre dichos pacientes.
Diseño: Análisis *post-hoc* de un ensayo clínico fase IV multicéntrico, aleatorizado, doble ciego.
Ámbito: Pacientes adultos, hospitalizados con neumonía nosocomial por *Staphylococcus aureus* resistente a meticilina.
Participantes: Pacientes tratados con linezolid (224) o vancomicina (224).
Intervenciones: Desde la perspectiva española se compararon costes y URS entre pacientes tratados con linezolid o vancomicina y entre los que desarrollaron fallo renal y los que no.
Principales variables de interés: Análisis de costes y URS.
Resultados: Los costes totales fueron similares (p = 0,69) en los pacientes tratados con linezolid (17.782 ± 9.615 €) o vancomicina (17.423 ± 9.460 €). La tasa de fallo renal fue significativamente menor en los tratados con linezolid (4 vs. 15%, p < 0,001). Los costes totales fueron mayores en aquellos que desarrollaron fallo renal (19.626 ± 10.840 € vs. 17.388 ± 9.369 €, p = 0,14). La URS (días de ventilación mecánica: 13,2 ± 10,7 vs. 7,6 ± 3,6, p = 0,21; días en UCI: 14,4 ± 10,5 vs. 9,9 ± 6,6, p = 0,30; días de hospitalización: 19,5 ± 9,5 vs. 16,1 ± 11,0, p = 0,26) y los costes totales (17.219 ± 8.792 € vs. 20.263 ± 11.350 €, p = 0,51) tendieron a ser inferiores en los pacientes tratados con linezolid que desarrollan fallo renal. Tras corregir el análisis por mortalidad, los costes diarios por paciente fueron similares (1.000 vs. 1.010 €; p = 0,98).
Conclusiones: Desde la perspectiva española, no hubo diferencias en la URS y los costes entre los pacientes con neumonía tratados con linezolid o vancomicina. El coste de linezolid fue contrarrestado por la menor incidencia de fallo renal.

Introduction

Methicillin-resistant *Staphylococcus aureus* (MRSA) is a global problem and a common cause of pneumonia in hospitalized patients.[1,2] Vancomycin is widely used for treating patients with serious MRSA infections, including hospital-acquired or healthcare-associated pneumonia.[3] Linezolid (oxazolidinone) is an alternative treatment option for nosocomial pneumonia (NP) caused by MRSA.[3,4] Results from a recently completed phase 4, multicenter, double-blind, randomized clinical trial enrolling patients with MRSA NP[5] show that clinical success at end-of-study (EOS) is higher in patients treated with intravenous (IV) linezolid (57.6%) compared to dose-optimized IV vancomycin (46.6%; *P* = .042; per protocol population).[6]

In Spain, more than 20% of invasive *S. aureus* isolates were resistant to methicillin in the year 2012. Results were similar in other European countries, with the majority reporting methicillin resistance in more than 10% and 11 countries reporting methicillin resistance in more than 20% of *S. aureus* isolates.[7] Results from the Extended Prevalence of Infection in the intensive care unit (ICU) (EPIC II) study suggest that MRSA prevalence is even higher in European Intensive Care Units. In this study, the most commonly isolated organism from European ICUs was *S. aureus* (20.5%) where 49.4% of *S. aureus* isolates were methicillin