Predictors of Mortality in Cancer Patients with Methicillin-resistant *Staphylococcus aureus* Bloodstream Infection

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**Abstract**

**Background:** Methicillin-resistant *Staphylococcus aureus* (MRSA) is a common healthcare associated infection, with a high mortality rate. Patients with active cancer have a high risk of bloodstream infection (BSI) and MRSA infection due to immune suppression from chemotherapeutic and frequent exposure to the healthcare environment. Data is lacking on the level of mortality for cancer patients with MRSA BSI, and so the aim of this study is to assess the mortality related to MRSA BSI in cancer patients.

**Methods:** This is a retrospective study performed in an integrated 4 hospital health system in Southeast Michigan. We evaluated 1173 consecutive individual patients with MRSA BSI over a 9 year period, from July 2005 to June 2014. Demographic, clinical, and microbiology data were obtained via review of electronic medical records. Patients were screened for having active cancer within 30 days before MRSA BSI. MRSA strain types were identified using pulse-field gel electrophoresis (PFGE) and patterns were compared using BioNumerics software. Isolates were considered to be in the same PFGE group if they had ≥80% similarity using the Dice coefficient. Isolate groups are based on categories set by the CDC.

**Results:** We identified 92 patients (46 males) with active cancer who had a MRSA BSI. The average age of patients was 66 years, 62 patients had solid tumors (45 with metastasis), and 30 hematologic malignancy. Treatment included chemotherapy in 40.2% of patients, radiotherapy in 19.6%, and steroids in 27.2%. All-cause mortality 30 days after index blood culture was 35.87%. Charlson score was 23 in 95% of patients. Vancomycin MIC by E-test was ≤1.5 μg/ml in 84% of MRSA isolates. USA 100 was the most common strain in 52.7% of BSIIs, followed by USA 300 at 30.8%, and USA 600 at 1.1%. Three factors on univariate analysis were statistically significant predictors of mortality: treatment with steroids 30 days before MRSA BSI (p=0.006), ICU admission during hospitalization for MRSA BSI (p=0.02), and patients with acute renal failure during MRSA BSI (p=0.02).

**Conclusion:** Our data show that patients with active cancer and MRSA BSI have high mortality of 35.87%. Recent treatment with steroids, admission to the ICU, and acute renal failure are significant predictors of mortality.

**Methods**

A retrospective study performed in an integrated 4 hospital health system in Southeast Michigan. We evaluated 1173 consecutive individual patients with MRSA BSI over a 9 year period, from July 2005 to June 2014. Patient data was collected via electronic medical records. Patients were screened for having active cancer within 30 days before MRSA BSI. MRSA strain types were identified using pulse-field gel electrophoresis (PFGE) and patterns were compared using BioNumerics software. Data on patients who did not experience mortality within 30-days of index blood culture was compared to data on patients who did experience mortality, and significance was determined using a Fisher Exact test.

**Results**

Among the 1173 patients evaluated, we identified 92 (46 males) with active cancer and a MRSA BSI. Below (Table 1) are the results of univariate analysis for each factor measured against 30 mortality.

**Table 1**. Results of univariate analysis, significant predictors of 30-day mortality.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>30-Day Mortality N (%)</th>
<th>No Mortality N (%)</th>
<th>OR (CI 95%)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>ICU Ever</td>
<td>17 (53.1)</td>
<td>16 (27.1)</td>
<td>3.0 (1.27-5)</td>
<td>0.022</td>
</tr>
<tr>
<td>Prior ICU</td>
<td>8 (25.0)</td>
<td>15 (25.4)</td>
<td>0.98 (0.36-2.6)</td>
<td>1.00</td>
</tr>
<tr>
<td>Prior Surgery</td>
<td>5 (15.6)</td>
<td>7 (11.9)</td>
<td>1.4 (0.44-7.5)</td>
<td>0.747</td>
</tr>
<tr>
<td>NH</td>
<td>5 (15.6)</td>
<td>5 (8.5)</td>
<td>2.0 (0.53-7.5)</td>
<td>0.313</td>
</tr>
<tr>
<td>CVC infected</td>
<td>5 (15.6)</td>
<td>17 (28.2)</td>
<td>0.46 (0.15-1.59)</td>
<td>0.204</td>
</tr>
<tr>
<td>Chemo</td>
<td>13 (40.6)</td>
<td>22 (37.3)</td>
<td>1.0 (0.74-2.7)</td>
<td>0.823</td>
</tr>
<tr>
<td>Neutropenia</td>
<td>5 (15.6)</td>
<td>4 (6.8)</td>
<td>2.50 (1.59-10.2)</td>
<td>0.27</td>
</tr>
<tr>
<td>Leukemia</td>
<td>5 (15.6)</td>
<td>10 (16.9)</td>
<td>0.9 (0.28-2.9)</td>
<td>1.00</td>
</tr>
<tr>
<td>Lymphoma</td>
<td>5 (15.6)</td>
<td>11 (18.6)</td>
<td>0.80 (0.25-2.6)</td>
<td>0.78</td>
</tr>
<tr>
<td>Solid Tumor</td>
<td>9 (28.1)</td>
<td>28 (47.5)</td>
<td>0.43 (0.17-1.1)</td>
<td>0.08</td>
</tr>
<tr>
<td>Metastasis</td>
<td>18 (56.3)</td>
<td>24 (40.7)</td>
<td>1.86 (0.76-4.4)</td>
<td>0.19</td>
</tr>
<tr>
<td>Steroids</td>
<td>15 (46.9)</td>
<td>10 (17.2)</td>
<td>4.2 (1.61-11.2)</td>
<td>0.006</td>
</tr>
<tr>
<td>Radiotherapy</td>
<td>9 (28.1)</td>
<td>9 (15.3)</td>
<td>2.2 (0.76-6.3)</td>
<td>0.17</td>
</tr>
<tr>
<td>CVC Present</td>
<td>19 (59.4)</td>
<td>44 (74.6)</td>
<td>0.50 (0.2-1.2)</td>
<td>0.16</td>
</tr>
<tr>
<td>Relapse</td>
<td>1 (3.3)</td>
<td>3 (5.1)</td>
<td>0.64 (0.1-6.5)</td>
<td>1.00</td>
</tr>
<tr>
<td>Readmission Infect</td>
<td>2 (6.3)</td>
<td>11 (18.6)</td>
<td>0.29 (0.06-1.4)</td>
<td>0.13</td>
</tr>
<tr>
<td>Prior Abb Use</td>
<td>17 (53.1)</td>
<td>36 (61.0)</td>
<td>0.72 (0.30-1.7)</td>
<td>0.51</td>
</tr>
<tr>
<td>Line Removed</td>
<td>6 (11.6)</td>
<td>23 (52.3)</td>
<td>0.42 (0.14-1.13)</td>
<td>0.17</td>
</tr>
<tr>
<td>Hemodialysis</td>
<td>4 (12.5)</td>
<td>3 (5.1)</td>
<td>2.67 (0.56-12.7)</td>
<td>0.19</td>
</tr>
<tr>
<td>TPN</td>
<td>0 (9.9)</td>
<td>5 (8.5)</td>
<td>0.92 (0.85-0.99)</td>
<td>0.16</td>
</tr>
<tr>
<td>CHF</td>
<td>5 (15.6)</td>
<td>9 (15.3)</td>
<td>1.02 (0.31-3.4)</td>
<td>1.00</td>
</tr>
<tr>
<td>Diabetes</td>
<td>8 (25.0)</td>
<td>23 (39.0)</td>
<td>0.5 (0.2-1.36)</td>
<td>0.25</td>
</tr>
<tr>
<td>Acute Renal Failure</td>
<td>10 (31.3)</td>
<td>6 (10.2)</td>
<td>4.01 (1.30-12.4)</td>
<td>0.014</td>
</tr>
</tbody>
</table>

**Conclusions**

- Our data show that patients with active cancer and MRSA BSI have high mortality of 35.87%.
- Recent treatment with steroids and admission to the ICU are significant predictors of mortality in patients with active cancer and MRSA BSI.
- CVC line removal 72 hours after index blood culture shows a significant protective effect.
- Further studies are needed to determine the optimal management of this patient population.