Impact of Hospital Length of Stay on the Distribution of Gram Negative Bacteria and Likelihood of Isolating a Resistant Organism in a Canadian Burn Centre

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ABSTRACT

OBJECTIVES

In a burns centre: 1) To characterize the distribution of Gram negative bacteria (GNB) over time 2) To identify changes in the susceptibility profile of GNB over time 3) To identify the proportion of multidrug resistant GNB infection over time

METHODS

Study Design • Retrospective review of patient data retrieved from the Stewardship Program Integrating Resource Information Technology (SPIRIT) database of the antimicrobial stewardship program at Sunnybrook Health Sciences Centre (SHSC).

Inclusion Impairments with a documented positive clinical (non-screening) culture for GNB at SHSC Ross Tilley Burn Centre (RTBC). Duplicates were excluded. A duplicate culture was defined as one growing the same organism with the same susceptibility profile, for the same patient identifier within 14 days or less of a prior specimen from that patient, regardless of specimen source.

Procedure Positive cultures were categorized into five time periods (in days) based on the specimen collection date relative to the patient’s date of admission: 0-7, 7-14, 14-21, 21-28, >28. Chi-square for proportions was used to compare the 5 time periods. When the p-value was <0.05, X2 statistic for proportions was used

RESULTS

Figure 1: Change in the proportion of a Gram negative bacteria (GNB) over a time period

Figure 2: Proportion of susceptible Gram negative bacteria to an antibiotic over each time period

Figure 3: Proportion of susceptible P. aeruginosa to an antibiotic over each time period

Figure 4: Proportion of susceptible Enterobacteriaceae to an antibiotic over each time period

Figure 5: Percent multidrug resistant Gram negative bacteria (MDR-GNB) for each time period

DISCUSSION

While acknowledging the limitations of retrospective analyses, this study provides insight to which GNB likely are leading to infection as a function of length of stay in a burn centre and identifies changes in susceptibility over time. The data suggests that burns patients in hospital beyond 14 days are more likely to suffer from P. aeruginosa and GNB with reduced susceptibility to available antibiotics compared to those whose length of stay is less than 14 days.

Table 1: Baseline Characteristics

<table>
<thead>
<tr>
<th>Variable</th>
<th>Number of Patients</th>
<th>0-7</th>
<th>7-14</th>
<th>14-21</th>
<th>21-28</th>
<th>&gt;28</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td></td>
<td>81(65)</td>
<td>86(63)</td>
<td>82(59)</td>
<td>84(62)</td>
<td>86(62)</td>
<td></td>
</tr>
<tr>
<td>Age (years) (Mean (SD))</td>
<td>49(19)</td>
<td>46(20)</td>
<td>50(15)</td>
<td>49(21)</td>
<td>46(19)</td>
<td>48(20)</td>
<td></td>
</tr>
<tr>
<td>Ceftriaxone susceptibility (%)</td>
<td></td>
<td>78(60)</td>
<td>75(60)</td>
<td>77(60)</td>
<td>79(60)</td>
<td>80(60)</td>
<td></td>
</tr>
<tr>
<td>Tobramycin susceptibility (%)</td>
<td></td>
<td>69(50)</td>
<td>68(50)</td>
<td>67(50)</td>
<td>68(50)</td>
<td>68(50)</td>
<td></td>
</tr>
<tr>
<td>Ciprofloxacin susceptibility (%)</td>
<td></td>
<td>80(55)</td>
<td>80(55)</td>
<td>80(55)</td>
<td>81(55)</td>
<td>82(55)</td>
<td></td>
</tr>
<tr>
<td>Ceftazidime susceptibility (%)</td>
<td></td>
<td>85(60)</td>
<td>85(60)</td>
<td>85(60)</td>
<td>85(60)</td>
<td>85(60)</td>
<td></td>
</tr>
<tr>
<td>Meropenem susceptibility (%)</td>
<td></td>
<td>89(65)</td>
<td>90(65)</td>
<td>90(65)</td>
<td>90(65)</td>
<td>90(65)</td>
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</tr>
<tr>
<td>Vancomycin susceptibility (%)</td>
<td></td>
<td>96(70)</td>
<td>96(70)</td>
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</table>

**RESULTS**

The impact of hospital length of stay (LOS) on the distribution and susceptibility of Gram negative bacteria (GNB) causing infection in burn patients remains unexplored.

**Objectives** To characterize the distribution of GNB causing infection and to identify changes in susceptibility with LOS in a tertiary care burn centre.

**Methods** A retrospective review of patients with documented positive clinical (non-screening) GNB cultures identified from the antimicrobial stewardship program database was completed. Duplicate cultures were excluded. Positive cultures included in the analysis were categorized into five clinically relevant time periods (in days) based on the specimen date of collection relative to the patient’s date of admission: 0-7, 7-14, 14-21, 21-28, >28. Chi-square for proportions was used to compare the 5 time periods. When the X2 value was <0.05, the Marascuilo procedure was used to identify where the significant difference(s) between the 5 time periods occurred.

**Results** The proportion of patients with clinical cultures for P. aeruginosa increased with hospital LOS (period 0-7: 8% vs period >28: 55%; p<0.05). Conversely, clinical cultures for K. pneumoniae occurred most commonly within the first 7 days of hospitalisation (period 0-7: 36% vs period >28: 0.7%; p<0.05). The proportion of Enterobacteriaceae isolation was highest between 7-14 day of hospitalization and lowest when LOS > 28 days (period 7-14: 62% vs period >28: 36%; p<0.05). Resistance to antibiotics was directly proportional to hospital LOS (% patients with multidrug resistant GNB increased from 6% (LOS 0-7days) to 44% (LOS >28days); p<0.05).

**Conclusions** This study provides objective evidence illustrating changes in species and resistance patterns of GNB causing infections in burn injury patients as a function of hospital length of stay.