

## Background

*Staphylococcus aureus* (SA) is one of the most common causes of prosthetic joint infection (PJI). Infections due to MRSA are associated with particularly severe clinical outcomes.

The purpose of this study was to identify predictors of PJI due to MRSA as compared to methicillin-susceptible *S. aureus* (MSSA)

## Method

A retrospective cohort study was conducted at Detroit Medical Center (DMC) (an 8-site healthcare system in Southeast MI with over 2200 beds) from 06/2005-12/2011.

All patients who had SA isolated from tissue and wound cultures within one year of primary and/or revision surgeries of hip and/ or knee joints were included.

All culture data were processed and reported by the DMC Clinical Microbiology Laboratory. CLSI breakpoints were used to define methicillin-sensitive SA (MSSA) and methicillin-resistant SA (MRSA). Percents were calculated after excluding missing data.

Parameters abstracted from electronic medical records during the time of surgery included patient's co-morbidities, tobacco use, surgical prophylaxis and other surgery related variables. Renal impairment was defined as serum creatinine higher than 2 fold from baseline or if the patient received hemodialysis or peritoneal dialysis.

Additional variables abstracted from DMC medical records included healthcare-associated exposures, invasive procedures, and immunosuppression within 3 months of SSI.

All analyses were performed by using IBM-SPSS statistics 20 (2011)

## Results

Fifty-one patients with PJI due to MRSA were compared to 49 patients with MSSA (Table 1). Of these patients, 58 had undergone hip arthroplasty and 42 knee arthroplasty.

The most common indication for arthroplasty was degenerative joint disease in both MRSA and MSSA PJI. Femoral neck fracture was more frequently a reason for arthroplasty in the MRSA PJI group than in the MSSA PJI group (20% and 7%).

The median time to diagnosis of PJI was 28 days (IQR 19-77).

The proportion of PJI due to MRSA was 59% in the hip arthroplasty group and 41% in the knee arthroplasty group.

The mean age of the cohort was 58± 14 years, 49 (49%) were male and 52 (52%) were African American.

Patients with PJI due to MRSA, as compared with MSSA, had an increased frequency of congestive heart failure (CHF), diabetes, peripheral vascular disease (PVD), renal impairment and longer length of stay during their surgical hospitalization (LOS) of > 3 days (p<0.05).

In multivariate analysis, independent predictors of PJI due to MRSA included PVD (OR=5.9, 95% CI 1.5-23.0), renal disease (OR=8.5, 95% CI 1.0-73) and LOS>3 days (OR=2.2, 95% CI 0.9-5.3) (Table 2).

## Conclusion

PJI due to MRSA was associated with underlying PVD, renal disease and LOS > 3 days.

These predictors of PJI due to MRSA can help to target efforts to prevent MRSA PJI; and to decrease the time to effective therapy among patients with MRSA PJI.

**Table 1: Bivariate Analysis of Risk Factors for Methicillin Resistant *Staphylococcus aureus* Prosthetic Joint Infections**

| Variables  | Whole Cohort<br>N (Valid Percent) | MRSA<br>N = 51<br>(Valid Percent) | MSSA<br>N =49 (Valid<br>Percent) | Odds Ratio<br>(95% CI)  | P value      |
|--|-----------------------------------|-----------------------------------|----------------------------------|-------------------------|--------------|
| Elderly (>65 yrs.)   | 29 (29)                           | 19 (37.3)                         | 10 (20.4)                        | 2.32 (0.94-5.70)        | 0.079        |
| <b>Variables at the time of surgery</b>                    |                                   |                                   |                                  |                         |              |
| Obesity  | 52 (55.9)                         | 24 (52.2)                         | 28 (59.6)                        | 0.74(0.33-1.68)         | 0.534        |
| Myocardial infarction                                      | 13 (13)                           | 7 (13.7)                          | 6 (12.2)                         | 1.14(0.35-3.67)         | 1.000        |
| Peripheral vascular disease                                | <b>18 (18)</b>                    | <b>14 (27.5)</b>                  | <b>4 (8.2)</b>                   | <b>4.26(1.29-14.04)</b> | <b>0.018</b> |
| Diabetes Mellitus  | <b>32 (32)</b>                    | <b>21 (41.2)</b>                  | <b>11 (22.4)</b>                 | <b>2.42(1.01-5.79)</b>  | <b>0.055</b> |
| Congestive heart failure                                   | <b>13 (13)</b>                    | <b>11 (21.6)</b>                  | <b>2 (4.1)</b>                   | <b>6.46(1.35-30.89)</b> | <b>0.015</b> |
| Renal disease  | <b>9 (9)</b>                      | <b>8 (15.7)</b>                   | <b>1 (2)</b>                     | <b>8.93(1.07-74.34)</b> | <b>0.031</b> |
| Chronic Lung disease                                       | 22 (22)                           | 14 (27.5)                         | 8 (16.3)                         | 1.94(0.73-5.15)         | 0.230        |
| Rheumatic disease  | 2 (2)                             | 0                                 | 2 (4.1)                          |                         |              |
| Other Connective tissue disease                            | 5 (5)                             | 3 (5.9)                           | 2 (4.1)                          | 1.47(0.24-9.19)         | 1.000        |
| Malignant Solid Tumor                                      | 9 (9)                             | 7 (13.7)                          | 2 (4.1)                          | 3.74(0.74-18.97)        | 0.160        |
| Skin ulcers  | 12 (12)                           | 4 (8.2)                           | 8 (16.3)                         | 0.46(0.13-1.63)         | 0.356        |
| Tobacco use  | 32 (32)                           | 15 (29.4)                         | 17 (34.7)                        | 0.78(0.34-1.82)         | 0.669        |
| Indwelling Devices   | 31 (31.3)                         | 19 (37.3)                         | 12 (25)                          | 1.78(0.75-4.23)         | 0.202        |
| Central lines  | 7 (13.2)                          | 6 (21.4)                          | 1 (4)                            | 6.55(0.73-58.76)        | 0.104        |
| Vancomycin for surgical prophylaxis                        | 28 (35.4)                         | 15 (36.6)                         | 13 (34.2)                        | 1.11(0.44-2.79)         | 1.000        |
| Cefazolin for surgical prophylaxis                         | 49 (73)                           | 25 (71.4)                         | 24 (75)                          | 0.83(0.28-2.47)         | 0.789        |
| Length of hospitalization during time of surgery (>3 days) | <b>55 (55)</b>                    | <b>34 (68)</b>                    | <b>21 (42.9)</b>                 | <b>2.83(.25-6.44)</b>   | <b>0.015</b> |
| Presence of drain after surgery                            | 17 (18.3)                         | 9 (19.6)                          | 8 (17)                           | 1.19 (0.41-3.40)        | 0.794        |
| <b>Variables within 3 months prior to surgery</b>          |                                   |                                   |                                  |                         |              |
| Invasive procedures  | 25 (25.8)                         | 13 (26.5)                         | 12 (25)                          | 1.08(0.44-2.69)         | 1.000        |
| Hospitalization  | 19 (20.4)                         | 13 (28.3)                         | 6 (12.8)                         | 2.69(0.92-7.85)         | 0.076        |
| Immunosuppression  | 14 (15.6)                         | 6 (13.3)                          | 8 (17.8)                         | 0.71(0.23-2.25)         | 0.772        |
| Cephalosporins   | 9 (9)                             | 6 (11.8)                          | 3 (6.1)                          | 2.04(0.48-8.67)         | 0.488        |
| Fluroquinolones  | 2 (2)                             | 1 (2)                             | 1 (2)                            | 0.96(0.58-15.79)        | 1.000        |
| Glycopeptide   | 10 (10)                           | 6 (11.8)                          | 4 (8.2)                          | 1.50(0.40-5.68)         | 0.741        |
| <b>Variables within one year prior to surgery</b>          |                                   |                                   |                                  |                         |              |
| SA Bacteremia  | 1 (1)                             | 1 (2)                             | 0                                |                         |              |
| H/O previous surgery                                       | 26 (26)                           | 16 (31.4)                         | 10 (20.4)                        | 1.78(0.72-4.44)         | 0.257        |

**Table 2: Multivariate Analysis of Risk Factors for Methicillin Resistant *Staphylococcus aureus* Prosthetic Joint Infections**

| Variables*   | Odds Ratio | 95% C.I. |       | P Value |
|--|------------|----------|-------|---------|
|  |            | Lower    | Upper |         |
| Length of hospitalization during time of surgery (>3 days) | 2.173      | .889     | 5.31  | .089    |
| Peripheral vascular diseases                               | 5.947      | 1.539    | 22.98 | .010    |
| Renal Disease  | 8.453      | .981     | 72.85 | .052    |

\*Controlled for Congestive heart failure and Diabetes mellitus