Abstract

Background: Normal temperature values in the postoperative setting have not been well characterized. While fever is commonly associated with infection, a postoperative fever may be a normal physiologic response.

Methods: We evaluated all patients who had elective knee arthroplasty and were discharged within 5 days at NorthShore University HealthSystem in Illinois between January 1, 2007 and December 31, 2013. Inpatient temperature, gender, age, BMI and measurement were extracted from the data warehouse. Group based trajectory modeling was performed to identify clusters of postoperative patients following similar progression of average temperature mapping over time, gender, age and BMI. Results: 5,793 patients' postoperative temperature curves were evaluated. Three hundred sixty six (6.5%), 372 (6.7%), 225 (4.4%) and 30 (4.3%) patients had a temperature greater than 100.4°F on postoperative days 0, 1, 2 and 3 respectively (patients censored on discharge). Average temperature trajectories were created over 18 time periods (total of 3 days), with each time period representing an hour interval when temperatures were likely recorded. Group 1 displayed a quadratic functional form whereas Groups 2, 3 and 4 displayed cubic polynomial (Table 1). Table 2 displays the significant predictors in all clusters, and included age (Group 2, likelihood estimate (LE) = 0.036, p<0.001), Group 3, LE = 0.027, p<0.001, reference Group 1 and BMI (Group 2, LE = 0.034, p<0.001, Group 3, LE = 0.063, p<0.001 and Group 4, LE = 0.71, p>0.001, reference Group 1).

Conclusions: Patients display different temperature trajectories following elective knee arthroplasty. Further work is needed to determine whether different trajectories indicate different likelihoods of an adverse event occurring. Group based trajectory modeling may allow for personalizing the interpretation of a temperature in the postoperative setting.

Background

•Normal human body temperature was characterized by Dr. Carl Wunderlich in the 19th century as being an average of 98.6°F (37°C), when normal physiologic perturbation, such as the postoperative setting

•Fever is typically associated with infection; however, a postoperative fever, as defined by a body temperature of 100.4°F (38°C) may be a normal physiologic response.

•Postoperative fever is a relatively common occurrence after surgery (10%-40%)

•They are frequently non-infectious

•They are usually related to the underlying physiologic perturbation of surgery

•They often provoke workups for infectious complications

•Those workups are invasive, costly and have been shown to be low yield

•We are interested in characterizing temperature expectations in such non-normal settings.

Methods

•Data were extracted for all patients who underwent knee arthroplasty between January 1, 2007 and December 31, 2013 at NorthShore University HealthSystem

•For each surgical episode information regarding the index hospitalization and any subsequent patient encounters within 30 post-operative days were extracted from the electronic data warehouse on MRN, demographics, comorbidities, vital, laboratory, microbiology, blood transfusions, all medications, length of surgery, start and end of surgery, length of hospital stay (LOS) and start and end time patient was on ventilator.

•Group-based trajectory modeling was used to study the developmental course of patient temperature trajectories by identifying clusters of individuals following distinctive trajectories of the outcome of interest.

•Analyses include

•Descriptive summaries of key variables

•Trajectory analysis of temperature measurements using a censored normal distribution with important characteristics such as age, gender, body mass index (BMI), whether the patient had diabetes or hypertension (HTN), and the actual procedure time (PTMins)

•Logit outcome analysis evaluating the proportion of patients who had LOS greater than 3 days

Results

Table 3 (Left, upper right and left): Maximum Likelihood estimates and outcome analysis: logit model results of postoperative knee arthroplasty patients in increments of 4 hours (BMI, Body Mass Index; HTN, Hypertension; PTMins: Procedure Time in minutes).

Table 4 (Left): Summary statistics by trajectory group

References

What is a Normal Postoperative Temperature? Group Based Trajectory Modeling in Postoperative Knee Arthroplasty Patients in a Large Health System

Nirav Shah, MD, MPH; Vivek Vegi; Ankit Dhingra; Chad Konchak; Jessica Ridgway MD; Rema Padman PhD; Daniel Nagin PhD; Ari Robicsek MD, 1, 3

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Table 3 (Left, upper right and left):

Maximum Likelihood Estimate

<table>
<thead>
<tr>
<th>Group</th>
<th>Parameter</th>
<th>Estimate</th>
<th>Error</th>
<th>Parameter = 0</th>
<th>Parameter = 1</th>
<th>P value</th>
<th>Odds Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Intercept</td>
<td>5.15911</td>
<td>0.04973</td>
<td>5.15016</td>
<td>5.1672</td>
<td>0.0000</td>
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<tr>
<td></td>
<td>BMI</td>
<td>0.00684</td>
<td>0.00269</td>
<td>0.01035</td>
<td>0.00386</td>
<td>0.0000</td>
<td>1.0069</td>
</tr>
<tr>
<td></td>
<td>Age</td>
<td>0.03695</td>
<td>0.00204</td>
<td>0.03246</td>
<td>0.04198</td>
<td>0.0000</td>
<td>1.0371</td>
</tr>
<tr>
<td></td>
<td>Diabetes</td>
<td>0.03334</td>
<td>0.00401</td>
<td>0.02873</td>
<td>0.03783</td>
<td>0.0000</td>
<td>1.0364</td>
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</tbody>
</table>

Table 4 (Left):

<table>
<thead>
<tr>
<th>Summary Statistics</th>
<th>Group 1</th>
<th>Group 2</th>
<th>Group 3</th>
<th>Group 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of patients</td>
<td>1,498</td>
<td>1,316</td>
<td>475</td>
<td>161</td>
</tr>
<tr>
<td>Number of patients who max temp &gt;100.4°F</td>
<td>142 (9.6%)</td>
<td>113 (8.6%)</td>
<td>47 (10.0%)</td>
<td>15 (9.3%)</td>
</tr>
<tr>
<td>Odds of max temp &gt;100.4°F</td>
<td>9.724 (9.724)</td>
<td>6.864 (6.864)</td>
<td>5.975 (5.975)</td>
<td>4.509 (4.509)</td>
</tr>
</tbody>
</table>

Figure 1 (Left): Maximum temperature trajectories of postoperative knee arthroplasty patients in increments of 4 hours.