The Association of Surgical Duration with Surgical Site Infection in Clean and Clean/Contaminated Plastic Surgery Procedures

Nima Khavanin, BS; Gidasio S De Oliveria, MD; Brittany L Vieira, BS; Robert McCarthy, PharmD; John YS Kim, MD

Purpose: The relationship between longer surgical procedures and the risk of surgical site infection (SSI) has yet to be rigorously defined. Multiple *in*-vitro studies suggest a dose and time-dependent relationship between anesthetic agents and surgical stress on perioperative immunosuppression.[1,2] This study aimed to assess and quantify the putative association between operative duration and the risk for SSI in plastic surgery.

Methods: The 2005-2013 American College of Surgeons NSQIP database were retrospectively reviewed. Patients with a chronic wound or wound infection, pre-operative sepsis or wound classification I or II were eliminated. In total 49,044 plastic surgery procedures performed under general anesthesia met inclusion criteria. Missing data was handled by multiple imputation. Operative time was standardized across individual *CPT* codes via z-score. Patient characteristics and outcomes were compared across z-scores quintiles. Multiple logistic regression explored the relationship while accounting for patient demographic and comorbidities. A 1,000 sample bootstrap regression and various sensitivity and subgroup analyses explored the stability of these results across multiple modeling parameters. Array approach sensitivity analysis quantified the effect of potential confounding variables on these results. Random forest analysis provided measures of importance for each of the 15 variables, including surgical duration, in the development of an SSI.

Results: Within plastic surgery, 1,375 patients (2.80%) experienced an SSI within 30 days of operation, including 918 superficial incisional, 311 deep incisional, and 160 organ/space SSIs. After adjusting for confounding variables, the relative likelihood of SSI increased by 5.2% (p=0.34) per standard deviation of operative time, and on average by 9.6% for each hour of surgery (95% CI 7.2-11.9%) across all plastic surgery procedures. The aggregate of 1,000 bootstrap samples yielded a beta for the z-score of operative time of 0.242 (p=0.40). A random forest analysis identified operative duration as one of the most important variables in SSI prediction (Figure 1).

Conclusion: This study provides the first large scale demonstration of the association between increasing SSI rates and operative duration in plastic surgery.

References:

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Figure Legend:

Figure1. Measures of predictor importance within plastic surgery; Results of a random forest analysis with 1,000 trees including the above variables, using the randomForest package for the R Statistical Computing Environment. MSE stands for mean squared error. The leftmost graph depicts the mean decrease in accuracy of each tree's SSI risk predictions when each variable is randomly permuted over the dataset. That is, using the same model the MSE is calculated using the original data and then again

with the same data except that one variable at a time is randomly permuted; the more important the variable, the worse we would expect the predictions to be when it is randomly permuted and therefore the larger the % increase in MSE. The rightmost graph depicts how much splitting a decision tree based on a given variable increases node purity as measured by the Gini index. More important variables demonstrate greater increase in node purity.