March 19, 2015

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In “Paradigm Shift,” New Model Built From Preoperative Data Predicts Risk of Back Surgery Failure

March 19, 2015, NATIONAL HARBOR, Md. – In findings the investigators believe have import for medicine even beyond the pain field, a predictive model using machine learning (ML) classifiers was 80 percent accurate in identifying patients who developed post-laminectomy syndrome (PLS). The results of the retrospective analysis, presented today at the 31st Annual Meeting of the American Academy of Pain Medicine, promise cost savings and improved surgery outcomes, the study authors said.

Using ML to predict PLS represents a new use in healthcare for algorithms that are used everywhere from law enforcement to Google. One of the investigators on the study said ML models could potentially change how patients are selected and evaluated for laminectomy surgery.

“Using purely preoperative data, we can predict patients that will likely develop PLS and identify good surgical candidates for a very costly procedure,” said Marc D. Yelle, M.D., Ph.D., a resident research assistant in the Department of Anesthesia, Critical Care and Pain Medicine at Massachusetts General Hospital in Boston, Mass. Perhaps most importantly, he said, ML could potentially identify modifiable risk factors that if addressed could lower a patient’s risk for PLS and make him or her a better surgical candidate.

Pain after lower-back surgery persists to an alarming degree, and predicting who is at risk is difficult. Estimates of PLS, also known as failed back syndrome, range from 10 to 40 percent (Bokov et al, Pain Physician 2011;14(6):545-57). Although risk factors for PLS include ethnicity, age, weight, employment status, severity of pain, psychological status and prior surgeries, evidence is weak and the associations are unclear.

“Pain from PLS is by definition equal to or worse than that experienced preoperatively,” Yelle said. “This is very hard on patients mentally, physically and psychologically. Additionally, treatment for PLS is challenging and very limited.”

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Further, PLS has a significant economic impact to both the patient and the U.S. healthcare system.

“Spine surgery represents one of the most expensive surgeries that we can offer our patients, and with greater than a quarter of patients failing and developing PLS, this is a significant drain on our healthcare system,” Yelle said. “Moreover, patients are left debilitated and may find it hard to return to work and to pay for additional treatment.”

The research team, led by department director and principal investigator David A. Edwards, M.D., Ph.D., used 14 preoperative variables for PLS to create a presurgical predictive risk model (PPRISM), which correctly identified PLS patients 80 percent of the time from retrospective data.

ML algorithms can take data from large, multidimensional, imperfect databases and use these data to predict outcomes. The algorithms have been used in many other fields from providing insights to law-enforcement agencies regarding the likelihood of terrorist attacks to predicting traffic patterns. In business, companies such as Amazon and Walmart use them to plan marketing strategies based on customers’ buying habits. To date, ML algorithms have had limited application in medicine; one exception is in intensive care units, where they are used to recognize patterns in a patient’s vital signs that may predict changes in condition.

“We believe our application of ML to predict PLS could represent a paradigm shift in the application of ML to both predict and advise clinicians on patient care,” Yelle said.

A weakness of the research comes from the information placed into the algorithms, because medical records are often incomplete and information can be misplaced, weakening a prediction. That said, the algorithm still reliably predicted patients who will develop PLS, suggesting a strong model based on incomplete data, Yelle said.

The next step is validation through prospective studies by making PPRISM part of the hospital electronic medical record system so that patients may be classified before surgery as being “at-risk” or “not at-risk” of PLS. Once validated, PPRISM models may provide automated prior authorizations for surgery, helping insurance payers and providers to reduce healthcare expenditures. In the future, in addition to aiding surgeons in patient selection, ML could provide accurate informed consent and resources physicians can use to educate their patients on likely outcomes.

*Poster 207 – Presurgical Predictive Risk Model for Lumbar Post-Laminectomy Syndrome*

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The American Academy of Pain Medicine is the premier medical association for pain physicians and their treatment teams with over 2,500 members. Now in its 32nd year of service, the Academy’s mission is to optimize the health of patients in pain and eliminate pain as a major public health problem by advancing the practice and specialty of pain medicine through education, training, advocacy and research. Information is available on the Academy’s website at www.painmed.org.

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