Reassessing Glycemic Index: Data-Driven HbA1c and Same Day Glucose Strata that Maximize the Likelihood of 90-Day Major Complications following Lumbar Fusion

Ivan Z Liu¹, Chloe Pontier Farnham¹, Amil Raj Agarwal, Philip M Parel, Theodore Quan², Wesley Michael Durand³, Michael Raad, Amit Jain

¹Medical College of Georgia, ²George Washington University, ³Johns Hopkins Hospital INTRODUCTION:

Diabetes mellitus (DM) is a known risk factor for wound complications and major complications following lumbar fusion surgery (LF). HbA1c is the gold-standard marker to understand preoperative glycemic control; whereas same-day serum glucose (SDG) levels are utilized as an important perioperative marker. Thresholds for undergoing surgery have been created based on these values, but established thresholds are either non-specific for lumbar fusion or have low power in predicting complications. As the prevalence of DM in LF patients increases, it is important to reassess the relationship of glycemic index and lumbar fusion. Therefore, the purpose of this study was to generate data-driven strata for preoperative HbA1c and SDG measures that maximize the likelihood of 90-day major complications and wound complications following LF.

METHODS:

Patients who underwent LF from 2013 to 2022 were identified using a national database. Patients were included if they had both a HbA1c level taken within 3 months before surgery and an SDG level. Distinct data-driven strata for HbA1c and same-day glucose levels were established using stratum specific likelihood ratio (SSLR) analysis. SSLR is a modified approach to analyzing Receiver Operating Characteristics (ROC) curves that identified data-driven thresholds that maximizes the likelihood of an outcome. The outcomes in this study included 90-day major complications and wound complications following LF. The incidence for each of these complications was recorded for all identified strata. To control for confounding variables, each stratum was then propensity-score matched to the lowest strata based on age, sex, hypertension, heart failure, chronic obstructive pulmonary disease, and obesity. The risk ratio (RR) for each stratum with respect to the lowest matched stratum was observed. A significance level was set at a p-value threshold of <0.05. RESULTS:

In total, 12,026 patients were identified who underwent LF. SSLR identified three data-driven HbA1c strata (4.5-5.4, 5.5-7.9, and 8.0+) and three SDG strata (60-159, 160-239, and 240+) that maximized the likelihood of 90-day major complications. SSLR was unable to identify any data-driven strata for 90-day wound complication rates. For HbA1c, when propensity-matched to the lowest strata (4.5-5.4), the risk of 90-day major complications sequentially increased as the HbA1c strata increased: 5.5-7.9 (1.689; p=0.001; 95% CI 1.242, 2.296), 8.0+ (2.313; p<0.0001; 95% CI 1.558, 3.433). For SDG, when compared to the propensity-matched lowest strata (60-159), the risk of 90-day major complications also sequentially increased as the SDG strata increased: 160-239 (1.343; p<0.0001; 95% CI 1.175, 1.535), 240+ (1.636; p<0.0001; 95% CI 1.305, 2.049).

DISCUSSION AND CONCLUSION:

We were successful in identifying data-driven strata for HbA1c and SDG that maximized the difference in risks for 90-day major complications but not 90-day wound complications in LF patients. In the preoperative setting, the identified HbA1c strata can be incorporated into risk calculators and utilized to risk-stratify patients with other known variables rather than be used as a threshold for undergoing surgery. In the perioperative setting, strict glycemic control of preventing an SDG from exceeding 160 can also help reduce the risk of major complications following LF. The multiple strata identified for HbA1c and SDG levels demonstrate that a single cut-off value as identified in prior literature may not be ideal for preoperative patient management. Rather, risk stratification incorporating our multiple HbA1c and SDG strata with other parameters may be a better approach to preoperative risk stratification and counseling for 90-day major complications following

	HBAIC Throdolds			Choose Thresholds			
	45-54	55-19	5.61	59-235	199-229	140	
Likelihood States (E.K)	9.45	1,16	1.84	9,94	1.18	1.0	
Lewer 97% Confidence Internal	9.56	1,88	1.46	9.92	1,09	1,40	
Upper 90% Confidence beneval	9.56	1.29	2.29	9.97	1.27	1.89	

905		
Total Population		
Number Per	centage (%)	
12,026		
1.9 ± 13		
5.416	45	
6,615	55	
7,920	66	
835	7	
4.326	36	
2.878	24	
2,818	24	

	0-м		M-9		u.	
90-Day Complications	ER (00%-CD)	Mile	BLOTH-CL	PAide	Monsos	rva
Sand Misjar Complications	MIT	REF	1441/362340	444	2310,96140	**
Durit	XXV	хар				
Septin	XXV	XXP	121(6.40-245)	678		
Assis Kildery Tejery	XXV	хээ	177(131429)	6,000	194(18430)	-9.80
Myroandid Schroline	207	XXF				
Streta	XXF	XXF	201(634430)	686		
Polesmany Karbolina	XXV	хар	LW (EM-0.12)	6300		
Total Wread Complications	107	X37	1.13 (6.89-1.30)	6309	2293.354369	1.004
SuperSchild SSE	MF	RSF	164 (075 4.54)	660	1.72 (8.96-1.64)	9394
Deep 558	MF	HEF	1.89874-2000	4:90		
Occupation	MY	ME				

	Name Day Classer Nirola						
	g-19		366 - 259		346+		
90-Day Complications	Pasange (%	o P-Value I	Secondary C	QP-Value P	осольце (QP-Value	
Total Major Complications	8.30	10.7	12.00	-0.000	19.92	<3.80	
Ports	8.57	REF	671	6.560	1.89	100	
Sepsia	2.10	107	2.11	6/119	2.91	0.112	
Assis Khiley Injury	3.80	127	6.76	10.000	18.46	<3.80	
Myscardid Infantise	1.84	REF	1.77	6.001	1.55	0.136	
Strake	0.90	REF	6,98	6.990	1,46	0.151	
Palmoney Embelon	1,66	107	2.22	6.040	1.79	0.874	
Total Wound Complication	5.35	157	641	6.000	2.01	0.000	
Secretarial SSI	3.39	327	431	6.000	4.79	0.180	

96-Day Complications	Same Rep Classes Strata								
	10-10		100-100		240 1				
	RR (PPN-CD)	Printer	BR DESIGN	PYMA	RR (PPN-CD)	rve			
Total Major Complications	REF	REF	134039150	-9.8901	184031-2861	-9,90			
Don't	XXY	FEF	139 (181-149)	100					
Suprin	XXV	837	100 (0.00 1.00)	0.281	120879-215	1,361			
Arate Kidney Sejary	XXV	KEF	144 (339-139)	-0.000	247 (3.89-2.76)	-9.30			
Movement Inforcios	XXV	KEF	131(6)(0)(36)	0.346	100(630-130)	1.005			
Nimbe	XXP	107	\$11 (6.09 (.40)	9.70	0H (LG LH)	8.308			
Paleonary Embolion	NET	107	127 (6.80 1.76)	9381	1756-130	8.201			
Total Fround Complications	XXV	107	131(649-140)	9011	122 (600-1.00)	120			
Nagor Brist 2023	XXV	137	1.0 (0.00 (1.05)	0.229	131629-146	1.000			
Deep SSE	XXY	FEF	101030140	9.298	146(65)240	1.154			
(house of the	947	817	1174576-000	950	1174040210	1.07			