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High triglyceride-glucose index is associated with low postoperative satisfaction in patients with posterior instrumented lumbar fusion

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Abstract. – OBJECTIVE: This study aimed to determine the effect of the preoperative triglyceride-glucose (TyG) index on the postoperative quality of life, patient satisfaction, and surgical outcomes in patients who underwent posterior lumbar instrumentation and fusion surgery.

PATIENTS AND METHODS: This was a retrospective single-center cohort study (n = 136). Patients were divided into three groups according to the TyG index: < 25th percentile (L), 25-75 percentile (N), and > 75th percentile (H). Pearson correlation analysis was used to evaluate the relationship between the TyG index and the quantitative variables. Scatterplot and receiver operating characteristic (ROC) curve analysis were used to assess the relationship of the preoperative TyG index with postoperative Oswestry disability index (ODI) and physical function (PF) scores.

RESULTS: The TyG index showed a significant correlation with postoperative ODI score. TyG index showed a significant negative correlation with postoperative PF score. On ROC curve analysis, postoperative ODI score ≥ 38 (optimal cut-off) had 79% sensitivity and 92% specificity for predicting high TyG index (group H) (*p* = 0.016). Postoperative PF score ≤ 80 predicted group H patients with 97% sensitivity and 75% specificity (*p* = 0.001). The area under the ROC curve was 0.74 (*p* = 0.016) for the postoperative ODI and 0.79 (*p* = 0.001) for the postoperative PF.

CONCLUSIONS: In patients who underwent posterior lumbar instrumentation and fusion surgery, a high preoperative TyG index may predict poor postoperative ODI and PF scores, indicating lower patient satisfaction.

Key Words:

Triglyceride glucose index, Lumbar instrumentation, Oswestry Disability Index (ODI), Short form-36 (SF-36), Spinal surgery.

Introduction

Elective posterior lumbar spinal fusion is among the most widely performed spinal surgeries worldwide[1]. In recent years, the frequency of spinal fusion surgery has shown a greater increase compared to other surgeries[2]. To improve the outcomes of spinal fusion surgery, it is imperative to identify and treat the comorbid diseases that increase the cost of treatment in the postoperative period. Diabetes mellitus (DM) is a known risk factor for infection and prolonged hospital stay in patients undergoing posterior lumbar fusion surgery[3]. Metabolic syndrome (MetS) is characterized by the presence of metabolic abnormalities such as obesity, glucose intolerance, hypertension, and dyslipidemia[4]. In a study[5] of patients undergoing spinal fusion surgery, the treatment cost was found to be higher in patients with MetS than in those without MetS. MetS was also found to be associated with a higher risk of complications and prolonged hospital stay after posterior lumbar interbody fusion surgery[3]. Similarly, obese patients who underwent lumbar fusion experienced greater blood loss, prolonged hospital stay, higher complication rates, and worse functional outcomes compared to their non-obese counterparts[6].

Insulin resistance (IR) refers to the impaired biological response to insulin hormone[7]. IR is a strong risk factor for cardiometabolic diseases and plays a key role in the pathophysiology of type 2 DM[8]. IR is also closely associated with MetS[9]. The hyperinsulinemic-euglycemic clamp (HEGC) test is the gold standard method to measure IR[10]. However, the recently developed TyG index based on the fasting triglyceride (TG) and plasma glucose (FPG) levels has been suggested as a reliable marker of IR[10]. A study[11] demonstrated a close relationship of the TyG index with MetS and its components.

The TyG index is used to indirectly assess insulin resistance with the help of fasting triglycerides and fasting glucose values[12]. It has shown an excellent predictive performance in determining insulin resistance when compared with the homeostasis model assessment of insulin resistance

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(HOMA-IR)[10] and HEGC[12,13]. Besides, it had a significant association with IR-related metabolic disorders in adults, and its reliability approximated that of the homeostatic model assessment-estimated insulin resistance (HOMA-IR) method[14]. In a study[15] conducted on Korean adults, TyG index was found to be even better than HOMA-IR in predicting non-alcoholic fatty liver disease. On the other hand, most other methods utilized to evaluate insulin resistance, such as the HEGC, and the plasma insulin and C-peptide assay, are costly and difficult to operate. Furthermore, they are not easily available in all laboratories and exhibit poor reproducibility. Hence, there is a need for new biomarkers that are easier to detect and more affordable.

The 36-Item Short-Form (SF-36) Health Survey form is a questionnaire for assessment of the quality of life of individuals[16]. The Oswestry disability index (ODI) is used to evaluate low back functional disability[17]. The TyG index can be measured using a simple method without incurring any additional cost. The aim of the present study was to assess the effect of preoperatively determined TyG index on the quality of life, patient satisfaction, and surgical outcomes of patients who underwent posterior lumbar instrumentation and fusion surgery.

Patients and Methods

Patients

This was a retrospective cohort study of spine patients who presented to a single university hospital (Faculty of Medicine, Tokat Gaziosmanpasa University) between January 2012 and December 2022. All subjects provided written informed consent for the use of their data for research purposes. Before commencing the study, ethical approval was obtained from the institutional ethics committee (23-KAEK-094). All data were retrieved from the electronic patient record system (Enlil Hospital Information Management System, Version V2.19.46 2019118, Türkiye) and the PACS software (Sectra Workstation Ids7, Version 21.2.11.6289; ©2019 Sectra Ab, Sweden).

Surgery was performed in patients who did not respond to conservative treatment and had low back and leg pain or neurological deficits. Stabilization and fusion surgery were performed in these patients with the transpedicular screw method[18]. Antibiotic prophylaxis was administered to prevent infection that may occur in the surgical area in the early postoperative period[19].

Inclusion and Exclusion Criteria

This study included patients who met all of the following criteria: patients aged ≥ 18 years who underwent posterior instrumented lumbar fusion, minimum duration of follow-up one year, availability of preoperative plasma glucose and serum triglyceride levels.

The exclusion criteria were previous history of lumbar spine surgery, patients with scoliosis, infection, tumor, or vertebral fracture, incomplete clinical records (including preoperative complete blood count, serum triglycerides, glucose level, preoperative and postoperative 12 month SF-36 and ODI scores).

Clinical Evaluation

Data pertaining to the following variables were collected: age, sex, height, weight, body mass index (BMI), comorbidities, fusion level (≤ 3 and > 3), perioperative complications, Charlson comorbidity index (CCI), length of hospital stay, American Society of Anesthesiologists (ASA) physical status, length of hospital stay, intraoperative blood transfusion, and TyG index.

Surgical indications were recurrent lumbar disc hernia (LDH), lumbar stenosis, and spondylolisthesis. Comorbidities included DM, hypertension (HT), coronary artery disease (CAD), chronic pulmonary disease (asthma), thyroid dysfunction, cerebrovascular disease, and chronic kidney disease (CKD). The postoperative complications were wound discharge, dural injury, urinary tract infection, and myocardial infarction.

BMI was calculated as mass (kg) divided by height (m) squared. The length of hospital stay exceeding 75 percentile was considered as prolonged hospitalization[3]. The following formula was used for the calculation of the TyG index: Ln [fasting triglycerides (mg/dL) × fasting glucose (mg/dL)/2][20]. The patients were classified into three groups based on their TyG index[21]. Those with the TyG index of < 25th percentile were classified as group L, those with 25-75th percentile were classified as group N, and those with > 75th percentile were classified as Group H. Patients were also stratified into three groups according to age: 18-44 years, 45-64 years, and > 65 years[22]. According to the number of spinal levels operated on, the patients were classified into two groups: < 3 levels and > 3 levels[3]. Complete blood cell counts were determined using a blood analyzer after anticoagulation with EDTA. Plasma glucose and lipid levels were determined using venous blood samples obtained after overnight fasting.

Follow-up at 12 months after surgery is an appropriate time point for postoperative evaluation[23]. For this reason, the ODI and SF-36 forms filled out by the patients at the preoperative and postoperative 12th-month follow-up were used.

The ODI is calculated using a 10-item questionnaire designed to measure the severity of pain during personal care, lifting, walking, sitting, standing, social life, sleeping and traveling, and the cognitive status of pain. Each item is rated on a scale of 0 to 5 points, and the maximum possible score of the index is 50[24]. The ODI score was calculated as a percentage.

The SF-36 questionnaire is a 36-item self-administered scale that addresses eight dimensions of life: physical functioning, social functioning, role limitations (physical and emotional), mental health, vitality, pain, and general perception of health[16].

Statistical Analysis

Continuous and categorical variables were presented as mean ± standard deviation and frequency (%), respectively. Between-group differences with respect to continuous variables were assessed using the Student's *t*-test and one-way analysis of variance. Contingency tables and Chi-square tests were used to assess the relationship between qualitative variables. Pearson correlation analysis was used to assess the correlation between quantitative variables. All statistical analyses were performed using SPSS 22.0 software (IBM Corp., Armonk, NY, USA); *p*-values lower than 0.05 were considered indicative of statistical significance.

Results

A total of 136 patients [98 female (72.1%) and 38 male (27.9%)] were included in this study. The mean age of patients was 66.4 ± 10.6 years (range, 36-89). The prevalence rates of various comorbid diseases in our cohort were as follows: DM (39.7%), HT (66.2%), CAD (36%), asthma (12.5%), thyroid dysfunction (10.3%), obesity (3.7%), CKD (2.2%), and CVD (1.5%). Blood replacement was performed in 13 (9.6%) patients. The characteristics of patients in our cohort are summarized in Table I. The mean glucose and TG levels were 139.35 ± 63.22 mmol/L and 149.54 ± 71.24 mmol/L, respectively. The mean TyG index in groups L, N, and H were 8.35 ± 0.3, 8.35 ± 0.3, and 9.73 ± 0.25, respectively. The distribution of the quantitative variables is shown in Table II.

Table I. Distribution of the qualitative variables.

Variables		n	%
Age (years)	18-44	3	2.2
	45-64	52	38.2
	65 and above	81	59.6
Gender	Female	98	72.1
	Male	38	27.9
Fusion level	≤ 3	86	63.2
	> 3	50	36.8
Lumbar disc hernia	No	72	52.9
	Yes	64	47.1
Lumbar stenosis	No	40	29.4
	Yes	96	70.6
Spondylolisthesis	No	94	69.1
	Yes	42	30.9
Complication	None	119	87.5
	Wound discharge	8	5.9
	Dural injury	6	4.4
	UTI	2	1.5
	MI	1	0.7
ASA grade	1	8	5.9
	2	69	50.7
	3	58	42.6
	4	1	0.7
Prolonged hospitalization	< 75 percentile	98	72.1
	≥ 75 percentile	38	27.9

UTI: urinary tract infection, MI: myocardial infarction ASA: American Society of Anesthesiologists.

Table II. Distribution of the quantitative variables.

Variables	Mean ± SD	Min.	Max.
TyG index	9.05 ± 0.55	7.51	10.28
Weight (kg)	75.32 ± 7.39	60.00	93.00
Height (meter)	1.7 ± 0.04	1.67	1.98
BMI (kg/m^2)	26.02 ± 2.5	19.45	30.84
Age (year)	66.43 ± 10.67	36.00	89.00
Length of hospital stay (day)	13.97 ± 7.74	3.00	60.00
Preoperative ODI score	50.39 ± 6.15	40.00	82.00
Postoperative ODI score	25.59 ± 9.06	10.00	48.00
Preoperative physical function score	48.6 ± 10.29	25.00	70.00
Postoperative physical function score	77.83 ± 10.93	50.00	100.00
Preoperative mental status score	59.06 ± 11.05	28.00	100.00
Postoperative mental status score	58 ± 14.6	36.00	92.00

TyG: triglyceride-glucose index, BMI: body mass index, ODI: Oswestry Disability Index.

Table III. Distribution of the qualitative variables according to the groups formed based on the TyG index.

		Groups according to the TyG index			
Variables		L n (%)	N n (%)	H n (%)	p
Gender	Female	22 (64.7)	51 (75)	25 (73.5)	0.537
	Male	12 (35.3)	17 (25)	9 (26.5)	
Fusion level	≤ 3	25 (73.5)	42 (61.8)	19 (55.9)	0.301
	> 3	9 (26.5)	26 (38.2)	15 (44.1)	
Lumbar disc hernia	No	17 (50)	40 (58.8)	15 (44.1)	0.346
	Yes	17 (50)	28 (41.2)	19 (55.9)	
Lumbar stenosis	No	14 (41.2)	15 (22.1)	11 (32.4)	0.124
	Yes	20 (58.8)	53 (77.9)	23 (67.6)	
Spondylolisthesis	No	19 (55.9)	51 (75)	24 (70.6)	0.140
	Yes	15 (44.1)	17 (25)	10 (29.4)	
CCI grouping	Low	25 (73.5)[a]	26 (38.2)[b]	10 (29.4)[b]	**<0.001**
	High	9 (26.5)[a]	42 (61.8)[b]	24 (70.6)[b]	
Perioperative complication	None	32 (94.1)	57 (83.8)	30 (88.2)	0.472
	Wound discharge	1 (2.9)	6 (8.8)	1 (2.9)	
	Dural injury	1 (2.9)	3 (4.4)	2 (5.9)	
	UTI	0 (0)	2 (2.9)	0 (0)	
	MI	0 (0)	0 (0)	1 (2.9)	
ASA grade	1	3 (8.8)	4 (5.9)	1 (2.9)	0.122
	2	23 (67.6)	33 (48.5)	13 (38.2)	
	3	8 (23.5)	30 (44.1)	20 (58.8)	
	4	0 (0)	1 (1.5)	0 (0)	
Prolonged hospitalization	< 75	27 (79.4)	51 (75)	20 (58.8)	0.125
	≥ 75	7 (20.6)	17 (25)	14 (41.2)	

Pearson Chi-square test was used. [ab]: means with a common letter in a row are not statistically different. CCI: Charlson comorbidity index, UTI: urinary tract infection, MI: myocardial infarction, ASA: American Society of Anesthesiologists.

Table IV. Correlation results between the TyG index and quantitative variables.

			1	2	3	4	5	6	7	8	9	10
1	TyG index	*r*	1	.172*	.225*	.148	.166	.177*	-.108	-.168	-.005	-.129
		p		.046	.008	.085	.053	.040	.212	.050	.954	.136
2	BMI	*r*		1	-.086	-.124	-.006	-.159	.032	-.057	-.055	.099
		p			.317	.149	.947	.064	.708	.513	.523	.251
3	Age	*r*			1	.293*	.040	.168	-.056	-.154	.005	-.073
		p				.001	.642	.050	.515	.074	.950	.397
4	Length of hospital stay	*r*				1	.177*	.244*	-.233*	-.117	-.134	-.010
		p					.039	.004	.006	.174	.120	.911
5	Preoperative ODI score	*r*					1	.374*	-.587*	-.387*	-.296*	-.019
		p						.000	.000	.000	.000	.828
6	Postoperative ODI score	*r*						1	-.292*	-.311*	-.084	-.067
		p							.001	.000	.330	.440
7	Preoperative physical	*r*							1	.462*	.375*	.023
	function score	*p*								.000	.000	.793
8	Postoperative physical	*r*								1	.188*	.060
	function score	*p*									.029	.489
9	Preoperative mental	*r*									1	-.024
	status score	*p*										.786
10	Postoperative mental	*r*										1
	status score	*p*										

Pearson correlation coefficient was used. *: It shows the relationship between the TyG index and quantitative variables results. TyG: triglyceride-glucose index, BMI: body mass index, ODI: Oswestry Disability Index.

In the literature, according to the CCI index, comorbidities are classified as low comorbidity (CCI < 2) and high comorbidity (CCI ≥ 2)[24]. In our cohort, the proportions of patients in the low and high comorbidity groups were 44.9% and 55.1%, respectively. As presented in Table III, there was no significant difference between the TyG index groups L, N, and H with respect to sex, fusion level, surgical indication types, complications, or prolonged hospitalization; however, there was a significant difference in terms of CCI grouping ($p < 0.001$).

Correlation results between the TyG index and quantitative variables are shown in Table IV. TyG index showed a significant positive correlation with BMI ($p = 0.046$, $r = 0.172$). The mean BMI of patients in TyG index groups L and H were 25.61 ± 2.58 and 26.31 ± 2.83, respectively.

The TyG index also showed a significant positive correlation with age. The mean age of patients in TyG index groups L and H were 63 ± 11.6 years and 67.9 ± 10.4 years, respectively. Less improvement in functional scores was detected with increasing TyG index. There was a significant correlation between the TyG index value and postoperative ODI score. The postoperative ODI scores in groups L and H were 23.52 ± 6.87 and 29.59 ± 10.69, respectively.

TyG index showed a significant negative correlation with postoperative physical function (PF) scores. The mean PF scores in groups L and H were 79.85 ± 11.77 and 73.82 ± 7.69, respectively.

TyG index showed no significant correlation with prolonged hospitalization ($p = 0.085$, $r = 0.148$), preoperative ODI score ($p = 0.053$, $r = 0.166$), preoperative PF score ($p = 0.212$, $r = -0.108$), preoperative mental status score ($p = 0.954$, $r = -0.005$), or postoperative mental status score ($p = 0.136$, $r = -0.129$).

There was no significant difference between TyG index groups L, N, and H with respect to preoperative ODI scores; however, the mean postoperative ODI score in group H was significantly different from that in groups L and N. Preoperative PF scores did not significantly differ between the TyG index groups L, N, and H, whereas the mean postoperative PF score in the TyG index group H was lower than that in groups L and N. The difference between pre-and postoperative ODI scores was 26.04 in the TyG index group L and 22.97 in the TyG index group H. The difference between pre-and postoperative PF scores was 31.03 in the TyG index group L and 28.67 in the TyG index group H.

The correlation of the preoperative TyG index with postoperative ODI and PF scores is demonstrated in Figures 1 and 2.

Results of receiver operating characteristic curve (ROC) analysis showed that the TyG index is a potential marker for predicting low postoperative sati-

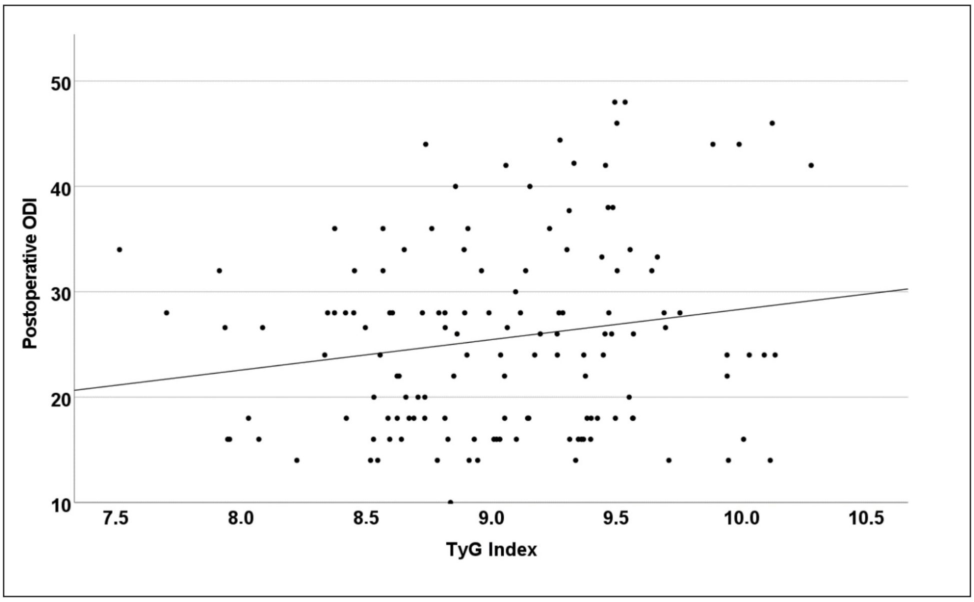

Figure 1. Scatterplot showing the correlation between the preoperative TyG index and postoperative ODI.

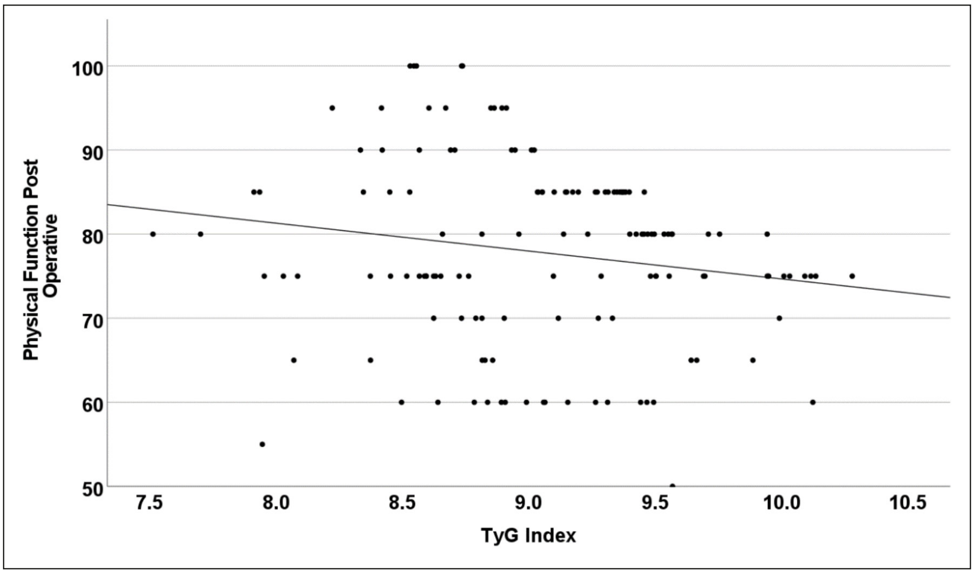

Figure 2. Scatterplot showing the correlation between the preoperative TyG index and postoperative physical function.

sfaction in patients who underwent posterior lumbar instrumentation and fusion surgery (Figure 3).

In patients with TyG index H, the postoperative ODI score ≥ 38 (optimal cut-off) had 79% sensitivity and 92% specificity (p = 0.016).

PF score ≤ 80 (optimal cut-off) predicted the patients whose TyG index was H with 97% sensitivity and 75% sensitivity (p = 0.001). The area under the ROC curve was 0.74 (p = 0.016) for postoperative ODI and 0.79 (p = 0.001) for postoperative PF.

Discussion

The number of patients with high TyG index undergoing posterior instrumented lumbar fusion surgery is expected to increase further, given the

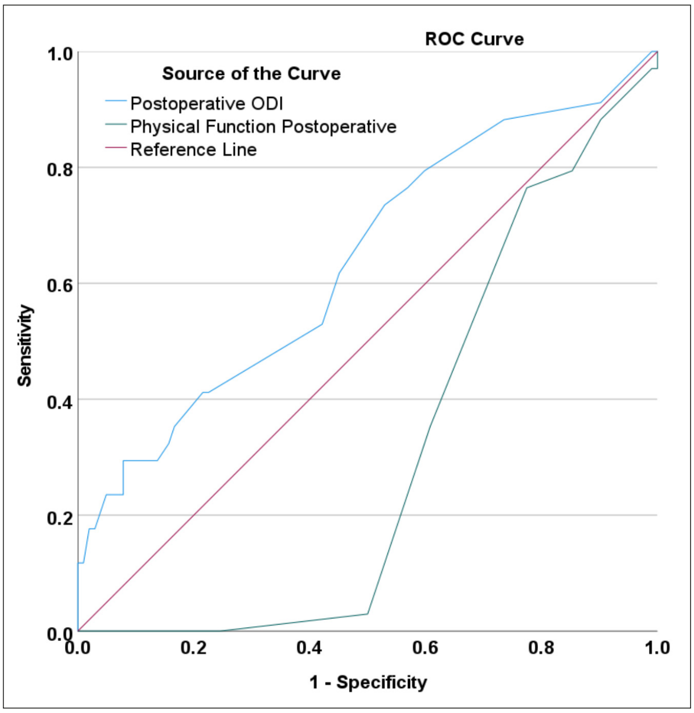

Figure 3. Receiver Operating Characteristic (ROC) curves for the postoperative Oswestry disability index (ODI) and physical function.

worsening worldwide IR epidemic and an aging population. The impact of metabolic factors on surgical outcomes, including spine surgeries like lumbar fusion, has been investigated in the literature. Factors such as metabolic health, including the TyG index, could potentially play a role in influencing postoperative recovery and satisfaction. Thus, it is important to assess the potential effects that a high TyG index could have on postoperative outcomes. High TyG index is linked with high rates of postoperative disability, particularly after instrumental spinal surgeries. The primary finding of the present study was that in patients with high preoperative TyG index, the postoperative ODI was higher, and the PF score was lower. These results indicate that the quality of life and satisfaction level of patients with high TyG index are lower and suggest that a high TyG index value is associated with end-organ damage, especially neuropathy[25], micro- and macro-angiopathies[26], and sarcopenia[27]. However, to the best of our knowledge, the present study is the first study exploring the relationship of the TyG index with postoperative satisfaction in patients who underwent posterior lumbar instrumentation and fusion surgery.

It has been reported that IR is one of the key risk factors of cardiovascular diseases, such as hypertension and vascular stiffness, and is associated with atherosclerosis progression[15,28-30]. IR, identified as a high-risk factor for diabetes, has been demonstrated to pose a risk for autonomic neuropathy in individuals with pre-existing diabetes[31]. IR might hinder the healing of wounds by influencing the complex interaction among impaired tissue regeneration, vasculopathy, neuropathy, and inflammation[32]. Besides, patients with diabetes who experience hyperglycemia resulting from IR are prone to the development of chronic wounds, such as Diabetic Foot Ulcer[32]. Significant association of the TyG index with the development of diabetes, cardiovascular diseases (CVD) and cardiovascular mortality indicates that IR contributes to the pathogenesis and CVD and metabolic diseases[30]. The TyG index can also be strongly linked to the progression of CKD[33]. Furthermore, there are studies[34-36] in the literature reporting significant associations between the TyG index and all-cause mortality among critically ill patients with diseases such as ischemic stroke, chronic kidney disease, and cardiac arrest. Zhao et al[37] found that there was a significant association between an elevated TyG index and a higher risk of both macro- and microvascular damage.

Spinal decompression fusion surgery in patients with DM is a challenging endeavor. DM increases the risk of end-organ damage, neuropathy, nephropathy, and retinopathy as well as poor surgical outcomes[38]. DM is a known risk factor for poor wound healing, surgical site infection, and low spinal fusion rates[39]. In our study, the observed relation between increased TyG index value, concomitant DM, and higher mean glucose levels were the expected results. However, the fact that there were DM patients also in groups L and N and that the mean glucose level in group L was higher than the normal plasma glucose level suggests that different parameters besides glucose may influence the quality of life of these patients.

In a study[40] of 98 patients undergoing surgery for LDH, ODI was found to be a useful marker for the assessment of postoperative 1-year follow-up results. The same study also revealed that the ODI significantly captures the disability scale in patients undergoing LDH surgery[40]. Thus, in our study, we considered appropriate to utilize the postoperative 1-year ODI score beside the SF-36 for the assessment of postoperative patient satisfaction. In a study[41] of patients who underwent lumbar spine surgery, patients with more comorbidities showed less improvement in postoperative SF-36 and ODI scores, and the improvement in these scores was lesser in patients with a greater number of comorbidities. In our study, the mean number of comorbidities in group H was significantly greater than that in group L. Our results are consistent with those of the aforementioned study. In a study[42] of 489 patients who underwent lumbar fusion surgery due to LDH, lumbar stenosis, or spondylolisthesis, patients with low preoperative ODI scores were found to be more likely to recover. Whereas in our study, despite having similar preoperative ODI scores, the postoperative ODI scores were observed to be higher in the TyG index group H, which confirms our hypothesis that high TyG scores indicate poorer outcomes and lower patient satisfaction.

A high TyG index indicates MetS[43]. In a previous study[3], MetS was found to be associated with increased perioperative risk in patients undergoing posterior lumbar interbody fusion. It has been stated in the literature that MetS occurs because IR increases the risk of obesity and endothelial dysfunction[44]. Obesity leads to an increase in adipokines and induces oxidative stress that causes hyperglycemia, inflammation, and activation of clotting pathways[45]. Endothelial dysfunction, on the other hand, renders patients more susceptible to proinflammatory and prothrombotic events by eliciting the elevation of certain cytokines and C-reactive protein, which in turn increases the likelihood of perioperative complications[46]. In a large study[47] (n = 6,696) assessing the impact of MetS on outcomes of spine surgery, MetS was found to be an independent risk factor for 30-day complications after adult spinal deformity surgery. Inflammatory cytokines induced by CKD may play a role in the activation of nuclear factor (NF)-κB by allowing increased expression of signal regulatory protein-a (SIRP-a)[48]. Besides, SIRP-a reduces tyrosine phosphorylation by interacting with insulin receptors, which causes the impairment of intracellular insulin signals, resulting in muscular dystrophy[49]. IR is known to be linked with skeletal muscle protein breakdown[50]. Considering the relationship of IR with sarcopenia[51], which is characterized by low physical performance together with low muscle strength or low muscle mass[21], it can be concluded that the relationship between the TyG index and sarcopenia may also be valid for patients undergoing posterior lumbar instrumentation and fusion surgery. Lower postoperative PF scores and higher ODI scores in patients with the TyG index group H support this finding.

In a cross-sectional study[52] conducted in 2020, the TyG index was found to be associated with low muscle mass in patients without DM and CKD. Our study presents new findings on the relationship between the TyG index and postoperative satisfaction in patients who underwent lumbar instrumentation and fusion surgery. In our study, patients with high TyG index had higher postoperative ODI scores and lower PF scores. These outcomes indicate the TyG index may help predict the quality of life in the postoperative period. We also observed a significant positive correlation between the TyG index values and BMI. In our study, BMI showed no significant correlation with any of the other parameters studied.

Limitations

Some limitations of our study should be considered while interpreting the results. This was a retrospective single-center study with a relatively small sample size. A larger multicenter study is required to obtain more definitive evidence.

Conclusions

In this study, the preoperative TyG index was identified as a potential predictor of the postoperative quality of life and patient satisfaction level after posterior lumbar instrumentation and fusion surgery. In our cohort, a low preoperative TyG index was associated with better postoperative ODI and PF scores, thus indicating higher quality of life and patient satisfaction. It may be useful to evaluate preoperatively the TyG index and, if necessary, manage it by treating triglyceride and glucose levels, to discuss the potential consequences if not treated with the patient, and to provide counseling to the patient on this matter. Further studies are required to identify all factors associated with poor outcomes of spine surgery.

Availability of Data and Materials

Data described in the manuscript, including all relevant raw data, will be freely available to any scientist wishing to use them for non-commercial purposes without breaching participants' confidentially.

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Authors' Contributions

Veysel Kıyak contributed to supervision, conceptualization, project administration, data collection, investigation, writing of original draft, and data curation. Martina Pontone was involved in the investigation, data curation, and editing.

Ethics Approval

The study has been authorized with the approval of the Ethical Committee of the Faculty of Medicine, Tokat Gaziosmanpasa University (committee approval 23-KAEK-094).

Informed Consent

Informed and specific consent was obtained from all participants included in the study.

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