Impact of Preoperative Nutritional Status on Postoperative Outcomes in Older Patients with Adult Spinal Deformities: A Retrospective Analysis

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INTRODUCTION:

Nutritional status has been recognized as a crucial factor in determining the risk of perioperative complications and recovery among older populations with multiple comorbidities undergoing surgery. Additionally, undernutrition can exacerbate muscle loss beyond typical aging-related declines, a condition known as sarcopenia, which significantly predicts functional decline. Studies in oncology have demonstrated a correlation between preoperative nutritional status and perioperative complications, underscoring the importance of assessing and managing nutritional status to optimize surgical results. In the context of adult spinal deformities (ASD), which progress with aging, the impact of nutritional status on surgical outcomes has not been extensively studied. This research investigates the relationship between preoperative nutritional status and muscle parameters such as psoas and paraspinal muscle mass, fatty infiltration, and radiographic sagittal parameters in older patients undergoing spinal fixation surgery. We also assess the influence of nutritional status on perioperative complications, long-term clinical outcomes, reoperation rates, and global sagittal alignment changes observed in full-body lateral radiographs.

METHODS:

This retrospective study involved elderly patients aged 65 and above with ASD, who underwent multi-segment spinal fixation involving three or more vertebral body levels at two medical centers between January 2017 and June 2020. A total of 130 patients were initially included, all of whom had a minimum follow-up period of 2 years postoperatively. Nutritional status was assessed using the Controlling Nutritional Status (CONUT: Table 1) scores, categorizing patients into normal nutrition (N; scores 0-1), undernutrition (UN; scores 2-12). The muscle mass index (MMI) and psoas muscle mass index (PMI) were measured using MRI at the L3 vertebral level. Multifidus muscle fatty infiltration (MMFI) was specifically defined as the presence of clear fatty infiltration, indicated by more than 50% fat within the muscle as observed on MRI. Radiological assessments of spinal deformity were performed using full-body lateral radiographs preoperatively, 2 weeks postoperatively, and 2 years postoperatively. Clinical and radiological outcomes were analyzed and compared between the groups using the Mann-Whitney U test for continuous variables and Fisher's exact test for categorical variables.

RESULTS:

Out of the initial 130 elderly ASD cases, 117 were eligible for analysis after excluding 13 due to insufficient clinical data or inadequate follow-up. The mean age was 73.3 ± 5.4 years, with 77 females (65.8%). Patients were divided into the UN group (50 patients) with varying degrees of undernutrition (light, moderate, severe) and the N group (67 patients) with normal nutrition. There were no significant differences in demographic data such as age, gender, and comorbidities between groups. The UN group displayed a lower PMI (5.3 ± 1.6 vs 6.1± 2.1 cm^2/m^2, P=0.044) and a higher incidence of MMFI (38.0% vs 10.4%, P<0.001) compared to the N group. (Table 2)

Preoperatively and 2 weeks postoperatively, there was no significant difference in sagittal alignment measures between the groups. However, at the 2-year postoperative follow-up, the UN group demonstrated significantly greater sagittal vertical axis (SVA: 56.5 ± 47.5 vs 44.2 ± 40.2mm, P=0.007) and smaller sacro-femoral angle (SFA: 194.4 ± 19.3 vs 202.6 ± 19.2 degrees, P=0.029) compared to the N group, indicating a regression in global sagittal alignment. The incidence of perioperative complications, proximal junctional kyphosis, and reoperation rates did not differ significantly between the groups. (Table 3)

DISCUSSION AND CONCLUSION:

The findings of this study indicate a significant association between preoperative undernutrition and increased fatty infiltration in the muscles of older patients undergoing surgery for ASD. Additionally, radiographical assessments revealed a progressive anterior trunk inclination in patients two years postoperatively. This inclination, or worsening of sagittal alignment, has been previously identified as a crucial determinant of quality of life (QOL) in patients with ASD. These observations highlight the impact of undernutrition and associated poor physical function on postoperative spinal alignment and overall patient outcomes. The results of this study emphasized the importance of comprehensive preoperative nutritional assessment and suggest that proactive nutritional management could significantly enhance surgical outcomes.

Table 1. Controlling Nutritional Status (CONUT) score

Serum albumin (g/dL)	≧3.50	3.00-3.49	2.50-2.99	<2.50
Albumin score: A	0	2	4	6
Total lymphocyte count (/mL)	≧1600	1200-1599	800-1199	<800
Total lymphocyte count score: B	0	1	2	3
Total cholesterol (mg/dL)	≧180	140-179	100-139	<100
Total cholesterol score: C	0	1	2	3
CONUT score (A+B+C)	0-1	2-4	5-8	9-12
Assessment	Normal	Light	Moderate	Severe

Table 2. Demographic and background vatiables of N group and UN group

	N group (n=67)	UN group (n=50)	*P*
Age, years	72.9± 5.7	73.8± 5.0	0.355
Sex, female	47 (70.1%)	30 (60.0%)	0.325
Height, cm	150.2± 20.8	153.6± 8.6	0.290
Weight, kg	53.5± 12.6	55.1± 8.7	0.375
PMI, cm^2/m^2	6.1± 2.1	5.3 ± 1.6	**0.044**
MMI, cm^2/m^2	4.0 ± 1.9	3.1 ± 1.5	0.076
MMFI, n(%)	7 (10.4%)	19 (38%)	**<0.001**
No. of fusion level	6.3± 5.4	6.2± 2.9	0.461
Fusion to the pelvis	32 (47.8%)	24 (48.0%)	1.000
preoperative JOA score	14.0± 4.9	13.1± 5.1	0.615
Comorbidity, cases			0.818
Cardiovascular	39 (58.2%)	27 (54.0%)	
Respiratory	1 (1.5%)	1 (2.0%)	
Diabetes Mellitus	15 (22.4%)	14 (28.0%)	
Cerebrovascular	6 (9%)	4 (8.0%)	
None	13 (19.4%)	10 (20.0%)	
Conut score, cases			
0-1	67	-	
2-4	-	37	
5-8	-	12	
9-10	-	1	

Table 3. Postoperative clinical scores, radiographic sagittal parameters of N group and UN group

	N group (n=67)	UN group (n=50)	*P*
Perioperative complications, cases	13 (19.4%)	11 (22.0%)	0.818
PJK occurrence (2 years), cases	4 (6.0%)	1 (2.0%)	0.391
Reoperation (2 years), cases	5 (7.5%)	5 (10.0%)	0.742
JOA score (2 years)	23.0 ± 3.7	21.8 ± 3.7	0.082
Preoperative radiographic parameters			
TK, degrees	32.5 ± 15.4	31.3 ± 13.6	0.437
LL, degrees	21.0 ± 18.7	22.6 ± 19.8	0.565
PI, degrees	50.8 ± 10.0	49.0 ± 11.9	0.273
PT, degrees	28.3 ± 11.7	26.7 ± 10.2	0.437
SVA, mm	99.5 ± 53.8	81.9 ± 53.6	0.135
SFA, degrees	197.1 ± 18.8	191.5 ± 19.2	0.129
KF, degrees	14.0 ± 6.8	12.2 ± 5.2	0.159
Postoperative radiographic parameters (2 weeks)			
TK, degrees	40.4 ± 15.8	38.8 ± 16.3	0.352
LL, degrees	38.9 ± 18.0	40.1 ± 19.5	0.860
PI, degrees	51.6 ± 10.2	50.3 ± 13.4	0.324
PT, degrees	19.0 ± 9.3	18.7 ± 9.9	0.875
SVA, mm	48.0 ± 61.3	29.3 ± 81.2	0.204
SFA, degrees	204 ± 20.3	198.1 ± 19.5	0.131
KF, degrees	8.1 ± 6.6	8.3 ± 6.9	0.854
Postoperative radiographic parameters (2 years)			
TK, degrees	44.6 ± 15.9	39.0 ± 16.2	0.101
LL, degrees	41.1 ± 13.7	34.9 ± 19.8	0.097
PI, degrees	52.2 ± 10.8	51.1 ± 12.8	0.251
PT, degrees	22.3 ± 9.1	21.9 ± 8.9	0.552
SVA, mm	44.2 ± 40.2	56.5 ± 47.5	**0.007**
SFA, degrees	202.6 ± 19.2	194.4 ± 19.3	**0.029**
KF, degrees	10.4 ± 6.3	11.8 ± 7.3	0.191