

## Research Article

# The Evaluation of Nutritional Serum Biomarkers as a Predictor of Post Operative Surgical Site Complications Risk in Elective Lumbar Spinal Surgical Patients

Thamer A. Hamdan\*, Nazar Haddad, and Ahmad A. Akbar

Department of Orthopaedic Surgery, Dean Basrah Medical College, Iraq

**\*Corresponding author**

Thamer A. Hamdan, Department of Orthopaedic Surgery, Dean Basrah Medical College, Basrah, Iraq, Email: thamerhamdan\_170@hotmail.com

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- Preoperative nutrition; Lumbar spine; Surgery; Albumin total; Lymphocyte count transferring; Post-operative infection

**Abstract**

**Background:** Preoperative nutritional status reflects a patient's ability to successfully undergo physically demanding surgical procedures, resist infections and heal of surgical incisions. Serum albumin, transferrin and total lymphocyte count are all nutritional biomarkers that are used to assess overall nutritional status. Malnutrition is frequently not identified during preoperative preparation of individuals who will undergo spine surgery.

**Patients and methods:** The prospective study which was conducted in the department of orthopedic surgery from March 2018–September 2019. A total of 48 patients that presented to the orthopedic department in Basra Teaching Hospital and Ibn-Albaitar private hospital had spinal lumbar surgery. The patients were investigated in form of total lymphocyte count, serum albumin, and serum transferrin preoperatively and at postoperative days 3, and 16th. The results and post-operative complications were recorded, and compared with pre-operative results.

**Results:** The patients was divided into two groups : Group(A) whom developed complications labeled as symptomatic patients were 5 (10.5%), 2 patients with spinal infection (discitis), 1 patient with delay wound healing, 1 patient with seroma formation and 1 patient with surgical site infection and group (B) labeled as asymptomatic whom not developed complications. From the total patients (48), preoperative investigations showed 8(16.6%) had low S. Albumin, 7 (14.5%) had low S. Transferrin, and 3 (6.2%) had low total lymphocyte count. In the symptomatic patients (n=5) 4 (80%) had low S. Albumin, 2 (40%) had low S. Transferrin and 1 (20%) had low total lymphocyte count.

**Conclusions:** Hypoalbuminemia is a risk factor for postoperative surgical site infection and wound healing problems.

**INTRODUCTION**

Back pain comprises the second most common reason for physician office visits [1]. Adults with back pain often elect surgical intervention and rates of spine surgery have substantially increased over the last 40 years, especially among older adult [2]. Because of increasing rates of spine surgery on increasingly older populations, higher complication rates may be expected. Understanding modifiable risk factors for the development of complications of spine surgery could facilitate pre surgical interventions to reduce risk [3]. Preoperative nutritional status reflects a patient's ability to successfully undergo a physically demanding surgical procedures, resist infection and heal from surgical incisions [4,5].

The preoperative nutritional status of the individual is an important predictor of morbidity, complications, and overall surgical success [6]. A well-nourished patient usually tolerates major surgery better than a severely malnourished patient. Several systemic factors can affect the rate of complications

following spine surgery, possibly compromising the clinical outcome [7].

**Aim of study**

To evaluate the impact of nutritional serum biomarkers changes in the pre and post-operative periods on elective lumbar spinal surgical patients.

**Patients and methods**

This is a prospective study which was conducted in the department of orthopedic surgery from "march 2018–September 2019", a total of 48 patients that present to the department for spinal lumbar surgery in Basra teaching hospital and Ibn-Albaitar private hospital.

**Inclusion criteria**

Include all patients of both genders with lumbar spine pathology diagnosed clinically and radiologically (MRI) and indicated for surgery. A detailed informed consent was taken

from the patients to be included in this study.

### Exclusion criteria

1- Malabsorption, pancreatic and liver diseases 2-Spinal tumor and patient on chemotherapy. 3-Immune compromised conditions (chronic steroid, renal failure and patients with haemoglobinopathies).

### Preoperative evaluation

Preoperatively, we took full history including medical, surgical, social and drug history. The BMI was calculated through the division of the weight (kg) by the squared height (m). The values of the BMI were classified in: <18.5 kg/m<sup>2</sup> (underweight); 18.5 to 24.9 kg/m<sup>2</sup> (normal); 25 to 29.9 kg/m<sup>2</sup> (overweight); and ≥30 kg/m<sup>2</sup> (obesity) according to the World Health Organization [8-11].

In addition to routine investigations were done by the hospital we emphasized on our investigations: Total lymphocyte count, Serum albumin, and Serum transferrin. Adequate amount of Venous blood sample has been drawn for every patient under aseptic technique one day preoperatively. The blood sample was taken for centrifuge and isolation of the serum.

For the classification of the nutritional status according to albumin, the following reference values were adopted: >3.5 g/dl (nourished), 3.0 -3.5 g/dl (mild malnutrition), 2.4 - 2.9 g/dl (moderate malnutrition), and <2.4 g/dl(severe malnutrition) [8].

The total lymphocyte count was calculated by using the lymphocyte percentage lymphocytes count in cells/mm<sup>3</sup>. The cut-off points used for the classification of the nutritional status according to the TLC were: >1500 cells/m<sup>3</sup> (normal), 1,200 to 1500 cells/m<sup>3</sup> (mild depletion), 800 to 1,199 cells/m<sup>3</sup> (moderate depletion), and < 800 cells/m<sup>3</sup> (severe depletion) [8].

The classification of the nutritional status according to serum transferrin the following reference values were adopted: > 200 mg/dL (nourished), 100-200 mg/dl (moderate malnutrition) < 100 mg/dl (severe malnutrition) [12].

The data was collected and analyzed in the statistics program SPSS, version 23.0 for Windows.

### Patients follow up

Postoperatively we follow the patient general condition in form of improvement of the preoperative symptoms and appearance of any new symptoms of fever, back pain, loss of appetite, and muscle spasm.

We took samples of venous blood (5cc) from all patients at third and sixteenth postoperative days. The sample sent for Total lymphocyte count, S.Albumin and S. transferrin in Basra teaching hospital.

## RESULTS

### Patient's characteristics

Forty eight patients were studied, all of them were diagnosed as a cases of lumbar Spine pathology(disk prolapse, spinal stenosis and spinal instability)lumbar spine surgery (lumbar laminotomy (fenestration), decompression with or without

fixation) was done for them, Eighteen males and thirty females, their age ranged from 19-69 years with a mean age of 44.3. The surgical procedures were fenestration in 17 patients, 23 patients had decompression and 8 patients had spinal fixation (whom received 1pint of blood and their skin closed on surgical drain).

L3-4 and L4-5 were the levels most commonly decompressed, and L4-5, L5-S1 were the levels most commonly fixed and L5-S1 was the level most commonly fenestrated. Thirteen patients (27%) were smokers, none was alcoholic at the time of the study, 28 (58.3%) patients were normal weight, 13 patients (27%) were overweight and 7 patients were obese (mean body mass index = 24.56.8 kg/m<sup>2</sup>). Fourteen patients (29%) were diabetic, 12 patients (25%) were hypertensive. Table 1,2 summarizes patient characteristics.

The patients were evaluated clinically and investigated in form of total lymphocyte count (N.R. 1500-4000cells/mm<sup>3</sup>), S. Albumin (N.R. 3.5-5 g/dl.), and S. Transferrin (N.R 200-360 mg/dl) one day preoperatively and at postoperative days 3, &16.

For the purpose of analysis and comparism the researcher consider the average result of the test for all the patients at the same time interval preoperatively and postoperatively as a single reading for that test.

### Development of symptoms

Patients considered as symptomatic with the development of

Table 1: Characteristics of patients involved in the study.		
Total number	48	
Male	18	
Female	30	
Mean Age ± std. deviation	44.3 ± 12.9	
Smoker	13 (27%)	
Non smoker	35 (73%)	
Diabetic	14 (29%)	
Not diabetic	34 (71%)	
Hypertensive	12 (25%)	
Non hypertensive	36 (75%)	
Mean BMI ± std. deviation	24.56.8 kg/m <sup>2</sup> ± 3.7	
Normal (18.5-25)	28 (58.3%)	
Overweight (25-30)	13 (27%)	
Obese (More than 30)	7 (14.7%)	
Surgical procedures		
Fenestration	17 (35.4%)	
Decompression	23 (48%)	
Fixation	8 (16.6%)	
	Decompression	Fixation
L2-L3	3	
L3-L4	8	
L4-L5	10	4
L5-S1	2	4
1 level fixation	7	Blood transfusion 8
2 level fixation L3-L5	1	Surgical drain 8

**Table 2:** Showed the patient's investigations results at time intervals.

Time	TLC(cells/mm3)		Albumin g/dl		Transferrin mg/dl	
	Mean	(STD)	Mean	(STD)	Mean	(STD)
Preoperative	1900	800	3.6	0.24	248	33.1
Postoperative day 3	1800	625	3.4	0.2	215	20.7
Postoperative day16	3000	685	3.6	0.17	221	29.3

STD = Standard Deviation

**Table 3:** Characteristics of Symptomatic patients.

Total number	5	
Male	2	
Female	3	
Mean Age ± std. deviation	47 ± 6.2	
Smoker	3 (60%)	
Non smoker	2 (40%)	
Diabetic	1 (20%)	
Not diabetic	4 (80%)	
Hypertensive	2 (40%)	
Non hypertensive	3 (60%)	
Mean BMI ± std. deviation	25.44.8 kg/m2 ± 4.2	
Normal (18.5-25)	3 (60%)	
Overweight (25-30)	2 (40%)	
Surgical procedures		
Fenestration	1 (20%)	
Decompression alone	2 (40%)	
Fixation	2 (40%)	
	Decompression	Fixation
L3-L4	1	
L4-L5	1	
L5-S1		2
1 level fixation		2
Blood transfusion	Yes =2	no =3
Surgical drain	Yes=2	no=3

**Table 4:** The results of Total lymphocyte count with Serum albumin and transferrin in symptomatic patients.

Time	Albumin		TLC		Transferrin	
	g/dl		Cells/mm3		Mg/dl	
	Mean	(STD)	Mean	(STD)	Mean	(STD)
Pre op	3.1	0.21	1500	702	213	18.6
P.O.D.3	3.1	0.21	1600	800	211	16.6
P.O.D.16	3.2	0.7	1600	810	215	19.1
P.O.Wk.6	3.4	0.7	1500	685	214	18.8

STD = Standard Deviation G/dl = gram per deciliter Mg/dl= milligram per deciliter Cells/mm3= cells per cubic milliliter

the symptoms and signs of:

1. Infection (surgical site or discitis)
2. Delay wound healing more than 14 days
3. Seroma
4. Wound dehiscence

Five patients 10.5% developed post operative surgical site complications were identified as (symptomatic patients.

For the symptomatic group of the patients (5 patients) 10.5% those patients were evaluated for 6 weeks postoperatively and the patients were monitored by following clinical features and investigations (Total lymphocyte count, S. Albumin, S.Transferrin). Table 3 summarizes the patient characteristics and Table 4. Summarizes the patient's investigations results.

The 1<sup>st</sup> patient: Fifty two year old male, smoker not diabetic and not hypertensive with normal body weight, developed surgical site infection at day 6 post operatively (spinal fixation

for L5-S1 instability was done and he received 1 pint of blood, the skin closed on surgical drain). This patient was treated conservatively.

The 2<sup>nd</sup> patient forty seven years old male smoker not diabetic but hypertensive and overweight developed seroma formation at day 10 post-operative (spinal decompression for L3-L4 spinal canal stenosis) treated conservatively.

The 3<sup>rd</sup> patient thirty nine years old female diabetic not smoker not hypertensive and normal weight developed delay wound healing at 3<sup>rd</sup> weak post-operative (spinal laminotomy for L5-S1 disk prolapse) treated conservatively.

The 4<sup>th</sup> patient forty three years old female not diabetic not smoker but hypertensive and normal weight developed spinal infection (diskitis), delay wound healing at 3<sup>rd</sup> weak post-operative (spinal decompression for L4-L5 spinal canal stenosis) treated conservatively.

The 5<sup>th</sup> patient fifty four years old female smoker, hypertensive not diabetic and overweight developed spinal infection, seroma formation at 3<sup>rd</sup> weak post-operative (spinal fixation for L5-S1 instability) treated conservatively.

Chi- squared test with p Value of < 0.05 consider as statistically significant was used for statistical analysis for any significant association between development of complications (symptomatic) and the factors listed in the (Table 5).

Paired sample T test with p Value of < 0.05 consider as statistically significant was used for Analysis of investigations results between symptomatic group (A) and asymptomatic group (B). As shown in Table 6.

There are statistical significant associations regarding investigations results of serum albumin between symptomatic

**Table 5:** Analysis of factors between symptomatic group (A) and asymptomatic group (B).

Variable	Symptomatic Group (n) 5	asymptomatic group (n) 43	P value
Age	Above 50	2	0.24
	Below 50	3	
Sex	Male	3	0.12
	Female	2	
BMI	Normal	3	0.24
	Overweight	2	
Smoking	Obese		0.12
		6	
Smoking	Yes	3	0.12
	No	2	
Hypertension	Yes	3	0.22
	No	2	
Diabetes	Yes	1	0.17
	NO	4	
Surgical procedures	Fenestration	1	0.65
	Decompression	2	
	Fixation	2	

**Table 6:** Analysis of investigations results between symptomatic and asymptomatic groups.

Variable	Symptomatic Group (n) 5	asymptomatic group (n) 43	P value	
Serum albumin G/dl (3.5-5)	Presurgical	3.1	3.5	0.04
	Postsurgical day 3	3.1	3.4	
	Postsurgical day 16	3.2	3.5	0.24
	Presurgical	213	292	
Serum transferrin Mg/dl (200-360)	Postsurgical day 3	211	295	0.24
	Postsurgical day 16	215	272	
	1500	2200		0.24
	1600	2500		
Postsurgical day 16 (1500-4000)	1600	2300		0.24

G/dl = gram per deciliter Mg/dl= milligram per deciliter Cells/m<sup>3</sup>= cells per cubic milliliter

and asymptomatic groups in pre and post-operative day 3.

The rate of complications risk and 95 % confidence interval according to presurgical level of albumin, transferrin and total lymphocyte count were evaluated as shown in (Table 7).

Hypoalbuminemic patients experienced an increased risk of any post-operative wound healing complications compared with normoalbuminemic patients. In the complicated group 80% had low serum albumin level, while 40% had low serum transferrin and only 20% had low total lymphocyte count. the relative risk was slightly more for albumin than transferrin and total lymphocyte count.

## DISCUSSION

The association of postoperative infectious complications with impaired nutritional status is common problem in hospitalized patients [9]. However, the link between impaired nutritional status and increased risk for surgical site and post-operative infections has been minimally studied among patients undergoing elective spine surgeries [10-12]. Early and accurate recognition and diagnosis of postoperative complications are crucial to ensure rapid and good recovery from the disease and also to prevent complications risk [13-15].

For our knowledge it is the first study of nutritional status and risk for surgical complications after spine surgery in Basra and south of Iraq. The prevalence of malnutrition in this study was low regarding BMI, more than half of the patient 56.6% were classified as normal according to the BMI .Rocha et al. [8], also found that half of the patients (50%) were classified as normal according to the BMI when assessing the postoperative nutritional risk of the patients.

Although the BMI is an internationally accepted method for the classification of nutritional status, it does not assess the body

**Table 7:** Complications risk according to presurgical level of albumin, transferrin and total lymphocyte count.

	Serum albumin		Serum transferrin		Total lymphocyte	
	g/dl	>3.5	mg/dl	>200	cells/m3	
	< 3.5		< 200		<1500	> 1500
Total N= ( 48)	8(16.6%)	40(83.4%)	7 (14.5%)	41(85.5%)	3 (6.2%)	45(93.8)
Complications N= ( 5)	4 (80%)	1 (20%)	2 (40%)	3 (60%)	1 (20%)	4 (80%)
Variables	RR( 1) 95% CI 0.6-1.2		RR( 0.9)1 95% CI 0.6-1.1		RR(0.4) 95% CI 0.3-0.6	

CI=confidence interval, mg/dL=milligrams per deciliter, N=number, RR=risk ratios

composition and has several limitations. A few studies mention the limitation of the BMI as a method that does not provide accurate information about weight alterations related to an increase in the lean body mass or body fat [8].

In the assessed patients, serum albumin were good nutritional predictors of postoperative complications, than serum transferrin and TLC as the parameters of albumin, transferrin and TLC decrease, the risk of surgical complications will increase. We compare our result with two different studies:

Rocha et al., assessed 69 surgical patients he found that 40% had low serum albumin were classified as malnourished and 73% had low TLC were classified as malnourished

The reasons that our findings differ from this study can be explained by several possibilities. First, a substantially higher prevalence of malnutrition was present in the previous patient studied, in the current study; the proportion of patients with malnutrition was 10.5%. With 16.6% had low serum albumin and 14.5% had low serum and transferrin and 6.2% had low total lymphocyte count. The other possibility was a largest sample size that only obtained albumin and total lymphocyte count and no transferrin measurement. Other possibility is that patients for whom presurgical albumin measures were ordered were sicker and therefore more likely to have complications than others.

The other study Takemoto, et al. [12], who assessed 247 adults undergoing elective spine surgery observed that there was no association of presurgical prealbumin and transferrin levels with 30-day risk of medical complications and no evidence reduction in risk with increasing level, the difference between this study and our study is the large sample of a broad range of elective spine procedures including cervical, thoracic and thoracolumbar and utilize serum prealbumin and transferrin which may reflect more acute changes in recent dietary intake and nutrition status than albumin.

The American Society for Parenteral and Enteral Nutrition [16,17] recommends as a way to diagnose malnutrition, a combination of clinical, biochemical, and anthropometric parameters used besides the subjective nutritional assessment. It is important to mention the limitations of this study, such as the size of the sample and the patients subjected to different types of spine surgeries with higher/lower degrees of severity. More studies are necessary in different populations in order for these parameters to be validated as a means of early detection of morbidity and mortality in spine surgical patients.

## CONCLUSIONS

1. Normal Nutritional status of the patients is the key way to prevent post-operative complications.

2. Surgeon Awareness and surveillance of the typical pattern of TLC, S.Albumin, and S.Transferrin in presurgical patients may help in early diagnosis of post-operative complication.

3. Hypoalbuminemia was a risk factor for postoperative surgical site complications, infection and wound healing problems.

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