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The effect of perioperative nutritional therapy on the cognitive functions and nutritional status in elderly patients with femoral neck fracture

Mucahit Taflan[a], Ahmet Sen[b], Basar Erdivanli[c,*]

[a] *Health Sciences University, Rize Government Hospital, Department of Anesthesiology and Reanimation, Rize, Turkey*
[b] *Samsun Education and Training Hospital, Department of Anesthesiology and Reanimation, Samsun, Turkey*
[c] *Recep Tayyip Erdogan University, Medical Faculty, Department of Anesthesiology and Reanimation, Rize, Turkey*

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Abstract

Aim: Femoral neck fracture is a common condition in the elderly. The catabolic state due to the neurohumoral response and poor nutrition is a threat to the fitness, immune system and cognitive functions in this age group. This study investigated the effect of a pragmatic nutritional therapy on laboratory markers of nutritional status, cognitive functions and postoperative complications in elective geriatric patients with femoral neck fracture.

Materials and Methods: A total of 47 patients were randomized into two groups: Study group was audited two times a day to ensure administration of 30 kcal/kg/day calorie and 1 kg/day protein. Control group received standard hospital care. Complete blood count and routine biochemistry tests, Mini mental test scores and triceps skinfold thickness were obtained at the day of admission to the study, before the day of surgery and on the 5th postoperative day. Blood products and postoperative complications were recorded.

Results: Postoperative Mini mental test scores were lower in the study group ($p<0.001$, 95% confidence interval: -10.4 to -5.5). Serum hemoglobin, total protein and albumin concentrations were decreased in both groups during the preoperative period; but were significantly higher in the study group on the 5th postoperative day ($p=0.010$, 0.002, <0.001, respectively). Triceps skinfold thickness values were significantly higher in the Study group (2.51 ± 0.24 vs 2.23 ± 0.28 in the Control group, Wilcoxon test, $p=0.001$). Number of transfused blood products and postoperative complications were lower in the Study group.

Conclusion: This study showed that perioperative nutritional therapy with daily audits may protect the cognitive functions and evaluated with pragmatic laboratory tests and a simple, bedside anthropometric measurement.

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Introduction

Delivery of sufficient and appropriate fluids and nutrition during the perioperative period is important to protect the function of the organs [1, 2]. Decrease in cardiac and lung functions would necessitate further supportive care such as intensive care units; whereas decrease in gastrointestinal and immune system would delay wound healing. Altogether, a vicious cycle of increased hospital stays, and prolonged recovery time would result in increased incidence of postoperative complications and further prolonged hospital stay [1, 3].

Dehydration is common in the elderly. Therefore, it is imperative to maintain a precise fluid balance during the perioperative period. Renal dysfunction may easily develop in this population. Since it is difficult to detect subtle renal dysfunction, appropriate fluid therapy should be applied during major operations [3].

Nutritional disorders, too, are common in the elderly due to loss of appetite and hormonal changes due to age. This is another factor increasing morbidity and mortality in this population [4, 5]. Comorbid diseases of the cardiovascular, pulmonary, endocrine and neurological systems are also common and effective in increasing mortality and morbidity [6].

Femoral neck fractures are frequently encountered in the elderly. Many complications are observed in these patients due to age-related metabolic disorders and trauma-induced catabolic process following orthopedic operations [7, 8].

This study aimed to investigate the effects of a protocol-

*Corresponding author:
Email address: berdivanli@gmail.com (Basar Erdivanli)

ized fluid and nutritional support in the elderly patients, scheduled for an operation due to femoral neck fracture.

Materials and Methods

Following approval of the Local Ethics Committee (date: 23.12.2016, number 40465587-31), patients over 65 years of age, ASA risk score II or III, scheduled for an elective operation with a diagnosis of femoral neck fracture were included in this study.

Patients who could not be followed up for at least 3 days before the operation, patients with a Mini-mental test (MMT) score <24 or who are not eligible to provide such a test, emergency cases, patients who received general anesthesia or any type of sedation, patients with systemic signs of infection or shock on the day of hospitalization, patients receiving parenteral nutrition during the day of randomization were excluded from the study.

With closed envelope technique, a total of 47 patients were randomized into two groups to either receive standard hospital care (Control group), or a protocolized nutritional therapy by the anesthesiology clinic (Study group). The Control group received ordinary meals provided by the hospital, which consisted of 2 liters of fluids and 1800 kcal diet.

The Study group was evaluated daily for their fluid and calorie needs and received the necessary supplements to achieve a goal of 30 kcal/kg/day calorie and 1 kg/day protein. Randomization was continued until the number of patients in both groups was 25.

On the day of hospitalization, in the morning of the operation and on the 5th postoperative day, complete blood count and routine biochemistry tests were obtained. On the day of hospitalization and 5th postoperative day, all patients were evaluated with a Mini mental test; and the triceps skinfold thickness of the dominant arm was measured with an 80 mm skinfold caliper (Holtain SFT Caliper, Holtain Ltd., England).

Surgical period was observed for occurrence of any adverse events such as hypotension, bleeding; the amount of fluid and blood products were recorded. Postoperative period was observed for any complications including delirium, renal failure, desaturation, pulmonary embolism, signs of infection and need for intensive care. Nausea-vomiting was evaluated with the verbal descriptive scale (VDS: 0: no nausea, 1: mild, 2: moderate, 3: severe) at the postoperative 6th, 24th and 72nd hours.

Anesthetic technique was standardized as spinal anesthesia to avoid any bias related to use of sedative drugs. Postoperative analgesia was standardized as 1 mg/kg tramadol and 15 mg/kg paracetamol administered in 1 hour.

The primary outcome of this study was any change in MMT score, and secondary outcomes were changes in triceps skinfold thickness and nutritional laboratory tests.

Statistical analysis

A MMT score below 20 was defined as moderate dementia. Since no patient with a MMT score <24 was included in this study, the mean difference between the groups was determined as 5 points. In order to determine the number of samples at the highest possible value, the standard deviation was determined as 6 by dividing 24 to 4. With a false positive probability of 5% and false negative probability of 8%, the required number of patients per group was calculated as 23.

Statistical analysis was done with SPSS 12 package program. Categorical data were evaluated by Chi-square test. The normality of numerical data was evaluated by Kolmogorov-Smirnov test. Data with normal distribution (laboratory data) were compared with Student's t-test, data that did not fit to normal distribution (operation time, intraoperative fluid balance, amount of intraoperative bleeding, triceps skinfold thickness, amount of blood products transfused in the postoperative period) were evaluated by Wilcoxon test. Statistical significance was taken as <0.05. Poststudy power analysis yielded 98% power with number of observations (per group): 23, true difference in means: 9.3, and standard deviation: 7.4 for the primary outcome (postoperative Mini Mental Test score).

Results

Data of a total of 47 patients were examined (Figure 1). Patient characteristics are given in Table 1. In summary, the data were similar across groups.

Patients in the Control group received a mean of 21±2.3 kcal/kg/day, the Study group received 28±3.1 kcal/kg/day (p<0.001). Six patients in the Study group (25%) did receive less than 25 kcal/kg/day on any day.

The duration of surgery was similar (Control group: 148±32 min, Study group: 155±36 min; Wilcoxon test, p>0.05). Intraoperative fluid balance was lower in the Study group (1417±428 ml) compared to the Control group (1778±512 ml), but the difference was not statistically significant (Wilcoxon test, p>0.05). Amount of intraoperative bleeding was similar (Control group: 452±39 ml, Study group: 461±48 ml; Wilcoxon test, p>0.05).

Postoperative MMT scores were found to be extremely low in the Control group (mild in 4 patients, moderate in 8 patients, and severe in cognitive functions in 4 patients). While postoperative MMT scores were similar to preoperative scores in the Study group, it was found that it decreased significantly in the Control group (p<0.001, 95% confidence interval: -10.4 to -5.5, Figure 2).

Laboratory data are given in Table 2. In summary, postoperative hemoglobin, albumin and total protein values were statistically significantly different between groups.

Triceps skinfold thickness decreased in both groups during the perioperative period. However, at the 5th postoperative day, it was significantly thicker in the Study group (2.51±0.24 vs 2.23±0.28 in the Control group, Wilcoxon test, p=0.001).

In the postoperative period, patients in the Study group received a lower amount of red blood cells, and no fresh frozen plasma, significantly low compared to the Control group. Also, number of complications was lower in the Study group (Table 3).

Postoperative nausea and vomiting in the Study group were significantly lower at the 6th hour and was absent at the 24th and 72nd hours (Table 4, p values <0.001 and 0.002, respectively).

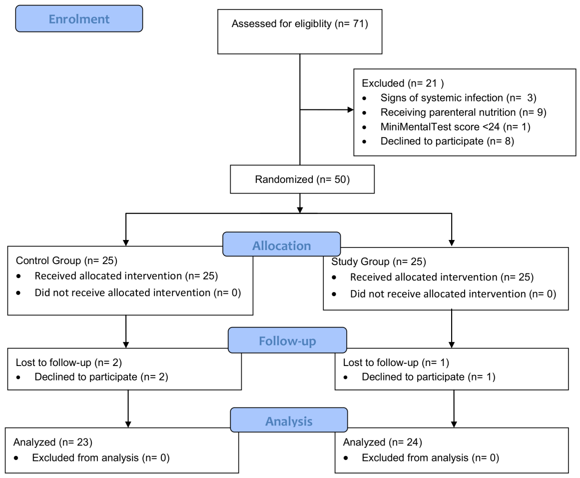

Figure 1. CONSORT flowchart of the study.

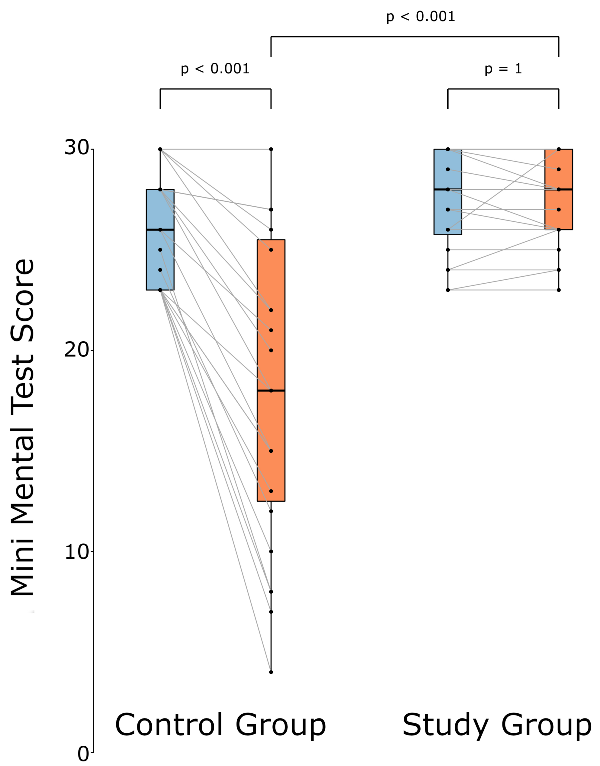

Figure 2. Pre- and post-operative Mini Mental Test scores.

Table 1. Patient characteristics. Data are given as number (percent%) or mean±standart deviation or number (percent%).

	Control(n=23)	Study(n=24)	p value
Age, years	80.3±12.1	77.8±6.9	0.382
Gender, n (%)Female Male	15 (65%)8 (35%)	16 (67%) 8 (33%)	1 α
Height, cm	162±8.6	165±7.2	0.254
Weight, kg	70.1±15.3	70.5±14.3	0.917
Body mass index, kg/m^2	26.5±4.8	25.8±4.3	0.614
Triceps skin fold thickness, cm	2.57±0.26	2.62±0.25	0.774
Mini Mental Test score	26.2±2.8	27.5±2.6	0.107
Comorbidities, n (%)			
Hypertension	13 (56%)	8 (33%)	0.192 α
Diabetes Mellitus	3 (13%)	3 (12%)	1 α
Coronary artery disease	3 (13%)	2 (8%)	0.959 α
Anemia	4 (17%)	5 (21%)	1 α
Asthma	1 (4%)	-	0.982 α
Alzheimer's disease	1 (4%)	1 (4%)	1 α
Acute renal failure	-	1 (4%)	1 α
Chronic renal failure	2 (8%)	-	0.451 α

Statistic: Independent Student T test, α=Crosstabs-Chi-Square

Discussion

This study showed that a protocolized administration of fluids and nutrition is able to protect total protein and albumin levels, cognitive function measured with Mini Mental Test, and triceps skinfold thickness.

The MMT score accurately showed the preserved cognitive functions in the Study group. Similar results were shown by Holte and colleagues in a large number of patients [9]. They showed that nutritional therapy improved cognitive functions, and decreased incidence of postoperative complications like nausea and vomiting, sleepiness and vertigo. Studies with similar results, albeit smaller number of patients are present [5, 6].

Gungen and colleagues reported the cut-off value of MMT in Turkish population as 23-24 [10]. Our patients had higher initial MMT scores. The decrease in MMT scores in the Control group is in accordance with the results of Ucuzal and colleagues, who found lower MMT scores in the first postoperative day in old surgical patients [11].

All patients had normal serum total protein and albumin levels in the beginning of this study. It is interesting to note that patients in Control group had significantly more complications despite this similarity. Almost one third of patients scheduled for a major surgery are diagnosed with malnutrition. Preoperative nutritional therapy is shown to

Table 2. Laboratory values. Results were obtained at the admission to the orthopedic ward (T1), the day before surgery (T2), at the 5th postoperative day (T3). Data are given as mean±standart deviation.

Laboratuary parameter	Control (n=23)			Study (n=24)			p value		
	T1	T2	T3	T1	T2	T3	T1	T2	T3
Hemoglobin, g/dl	11.7±1.71	1.2±1.41	0.2±0.9	11.7±1.6	10.9±1.2	10.9±0.9	0.877	0.484	**0.010***
Urea, mg/dl	58.5±30.6	54.7±27.8	49.2±31.7	43.8±20.6	43.3±25.7	35.5±13.9	0.062	0.150	0.067
C-reactive protein, mg/dl	1.1± 0.7	0.2±0.3	0.9±0.8	0.9±0.4	0.8±0.3	0.7±0.2	0.211	0.294	0.248
Aspartate aminotransferase, IU L-1	25.3±10.9	25.3±12.2	28.6±12.8	22.8±12.4	26.5±16.7	35.2±17.4	0.458	0.779	0.145
Alanine aminotransferase, IU L-1	16.3±8.1	18.4±9.4	14.6±8.2	18.5±7.5	18.1±6.1	23.7±7.6	0.651	0.922	0.121
Total Protein, g/dl	6.7±0.9	5.9±0.7	5.3±0.5	6.3±0.7	5.6±0.6	5.8±0.6	0.101	0.089	**0.002***
Albumin, g/dl	3.6±0.6	3.1±0.5	2.7±0.3	3.6±0.5	3.0±0.4	3.0±0.4	0.717	0.634	**0.001***
Sodium, mmol/L	138.4±2.51	36.8±2.8	136.8±3.3	137.0±2.9	135.9±3.0	138.1±2.9	0.096	0.314	0.197
Potassium, mmol/L	4.5±0.7	4.4±0.6	4.1±0.6	4.3±0.5	4.3±0.6	4.1±0.5	0.335	0.293	0.990
Calcium, mmol/L	8.8±0.7	8.3±0.7	7.9±0.5	8.6±0.6	8.3±0.6	8.5±0.5	0.390	0.842	**< 0.001***
Glucose, mg/dl	32.1±29.6	122.7±33.3	116.0±50.5	139.6±62.6	144.7±57.2	120.7±36.9	0.601	0.114	0.723

Statistic: Independent Student T test

Table 3. Transfused blood products and complications in the postoperative period. Data are given as median (interquarile range [min-max]) or number (percent%).

	Control(n=23)	Study(n=24)	p value
RBC, pack	3 (2-5 [1-8])	2 (0.75-3 [0-5])	**0.001***
Patients who received at least 3 RBC, n (%)	16 (69%)	7 (29%)	**0.013*** α
Patients who received FFP, n (%)	18 (78%)2 (8.6%)3 (13%)	24 (100%)	**0.018*** α
Patients receiving albumin, n (%)	1 (4.3%)	-	0.302 α
Postoperative complications, n (%)			
Delirium	8 (34.8%)	1 (4.3%)	**0.008*** α
Acute renal failure	1 (4.3%)	-	0.302 α
Fever	1 (4.3%)	2 (8.7%)	1 α
Pulmonary embolus	1 (4.3%)	-	0.302 α
Wound infection	2 (8.7%)		1 α
Respiratory insufficiency	4 (17.4%)	-	**0.033*** α
Admission to intensive care unit	1 (4.3%)	1 (4.3%)	1 α

RBC: Red Blood Cell Pack, FFP: Fresh Frozen Plasma pack, Statistic: Independent Student T test, α=Crosstabs-Chi-Square

decrease duration of hospital stay and incidence of postoperative complications [12].

We observed that serum total protein and albumin levels decreased in both groups during the preoperative phase. This is possibly related to increased need for proteins and energy due to the trauma and stress response. Gibbs and colleagues reported low preoperative serum albumin level as a predictor of poor prognosis [12]. A negative nutritional balance is also known to cause poor prognosis [13].

We are in opinion that the decreasing trend of biochemistry test results in both groups do reflect the catabolic process. Almost all cases of femoral neck fracture reported in the literature are circa 80 years old [14-16]. The seemingly old patient population cared in Orthopedics clinics increases incidence of nutritional disorders. The accompanying disorders in immune system, delayed wound healing and insufficient respiratory capacity are the main causes of prolonged hospital stay and morbidities [17, 18].

On the other hand, the increase in serum total protein and albumin and triceps skinfold thickness suggests a conversion to anabolic state in the Study group. Although anthropometric measurements are helpful, it is not advised to be used as the sole measure [19]. We are in opinion that triceps skinfold thickness accurately showed both the catabolic state in the Control group, as well as the anabolic state in the Study group. Therefore, although we agree with the abovementioned statement, we do believe that triceps skinfold thickness is a very helpful measure in old, orthopedic surgical patients.

Nutritional disorders in the preoperative period are known to increase the incidence of postoperative complications [20, 21]. Accordingly, we observed high numbers of cases with acute renal failure, pulmonary emboli, fever, need for intensive care and exitus in the Control group. However, this study was not designed nor powered to analyze any causality.

Significantly more blood products were used in the control group during the postoperative period. Despite this,

Table 4. Postoperative nausea and vomiting. Data are given as number (percent%).

Postoperative time	Score	Control(n=23)	Study(n=24)	p value
6th hour	0 12	4 (17%)10 (43%) 9 (39%)	19 (79%) 5 (22%)	**0.001*** α
24th hour	0 12	12 (52%)8 (35%) 3 (13%)	24 (100%)	**0.002*** α
72th hour	0 12	19 (83%)3 (13%) 1 (4%)	24 (100%)	0.102

Statistic: Crosstabs-Chi-Square

there was a trend towards decrease in serum hemoglobin concentration in the Control group, contrary to the Study group. Since we limited the blood samples to prevent iatrogenic anemia and hemodilution, we do not have any laboratory results to further explain the reasons. However, we hypothesize that a shorter catabolic state and reduced inflammation are the main reasons.

The enteral nutrition guideline of ESPEN suggests better outcomes with a preoperative nutritional therapy in patients with serious malnutrition [21]. They emphasize that this protocol reduces stress response and improves wound healing. We observed no wound infection in the Study group. Similarly, Kose and colleagues observed no hypoproteinemia or wound infection in patients, who received oral nutrition support [22].

Oral nutritional supplements are cheap products, containing sufficient lipid, protein and calorie in a pleasant way [23]. We put an effort to find the suitable oral supplement for each patient in the Study group. As a result, we observed that no patient had inappetence. This is important since poor compliance to nutritional therapy was shown to limit its effectiveness [24]. It is interesting to note that no patient in the study group had nausea and vomiting except the day of surgery. To minimize the effect of tramadol, we administered tramadol in 1 hour, strictly. However, the large difference between the two groups and occurrence of nausea and vomiting in the Control group after the first postoperative day suggests that this complication may be related to the condition of the gastrointestinal tract, although this study was not designed to test this hypothesis.

It is known that blinding in clinical trials of nutritional interventions are notoriously difficult and requires more than just covering or relabeling the nutritional products [25]. Although we expected a nocebo effect, that is some unexpected side effects in the Study group due to the addition of commercial nutritional products, we observed that the interest of nurses and relatives of other patients caused a gradual increase in the overall nutritional scores of the ward. This may have caused a bias in favor of the Control group and increase the Type II error.

This study has some additional limitations. We did not use any costly, impractical laboratory test in this study. Instead, common laboratory parameters like serum albumin, and a bedside anthropometric measurement was used. Although this limited the reasoning about the results, it proved as a pragmatic way to evaluate the nutritional status of surgical patients. This is in accordance with a recent feasibility study by Barrimore and colleagues, who suggest use of pragmatic or registry-based trials when evaluating nutritional interventions in hip fracture patients [26]. Secondly, transfusions of blood products in the postoperative period were not protocolized; it was left to the discretion of the attending surgeon. However, it should be noted that these transfusions were planned according to the orthopedic guidelines. These guidelines prioritize wound healing and suggest higher transfusion thresholds compared with the anesthesiology guidelines. We are in opinion that this difference between groups emphasizes the improvement associated with the protocolized nutritional therapy.

Conclusions

Preoperative nutritional therapy may reduce incidence of postoperative cognitive dysfunction, complications and loss of subcutaneous fat. Although this pragmatic study showed some solid proofs, these should be verified with studies employing higher number of patients, since this is a grey zone [27].

References

1. Aykaç ZZ, Arslantaş MK. Sıvı Tedavisi ve Yönetimi. GKDA Derg. 2017;23(2):35-42.
2. Erol DD. Perioperatif sıvı tedavisi: Güncel yaklaşımlar. T Klin J Med Sci. 2007;27(6):894-901.
3. Cengiz M. Geriatrik Hastalarda Ameliyata Hazırlık ve Anestezi. Turkiye Klinikleri J Orthop & Traumatol-Special Topics. 2008;1(2):61-8.
4. Shim HJ, Jang JY, Lee SH, et al. The effect of positive balance on the outcomes of critically ill noncardiac postsurgical patients: a retrospective cohort study. J Crit Care. 2014;29(1):43-8.
5. Yin K, Ding J, Wu Y, et al. Goal-directed fluid therapy based on noninvasive cardiac output monitor reduces postoperative complications in elderly patients after gastrointestinal surgery: A randomized controlled trial. Pak J Med Sci. 2018;34(6):1320-5.
6. Nikkel LE, Fox EJ, Black KP, et al. Impact of Comorbidities on Hospitalization Costs Following Hip Fracture. J Bone Joint Surg Am. 2012;94(1):9-17.
7. Partridge JS, Harari D, Martin FC, et al. The impact of preoperative comprehensive geriatric assessment on postoperative outcomes in older patients undergoing scheduled surgery: a systematic review. Anaesthesia. 2014;69(1):8-16.
8. Preston SD, Southall ARD, Nel M, et al. Geriatric surgery is about disease, not age. J Roy Soc Med. 2008;101(8):409-15.
9. Holte K, Klarskov B, Christensen DS, et al. Liberal versus restrictive fluid administration to improve recovery after laparoscopic cholecystectomy: a randomized, double-blind study. Ann Surg. 2004;240(5):892.
10. Güngen C, Ertan T, Eker E, et al. Standardize mini mental test'in Türk toplumunda hafif demans tanısında geçerlik ve güvenilirliği. Turk Psikiyatri Derg. 2002;13:273-81.
11. Ucuzal M. Yaşlı hastalarda ameliyat sonrası bilişsel değişiklikler. Turkish J Geriatrics. 2008;11:119-27.
12. Bauer JM, Wirth R, Troegner J, et al. Ghrelin, anthropometry and nutritional assessment in geriatric hospital patients. Z Gerontol Geriatr. 2007;40:31-6.
13. Bruce D, Laurance I, McGuiness M, et al. Nutritional supplements after hip fracture: poor compliance limits effectiveness. Clin Nutr. 2003;22(5):497-500.
14. Kruizenga HM, Van Tulder MW, Seidell JC, et al. Effectiveness and cost-effectiveness of early screening and treatment of malnourished patients. Am J Clin Nutr. 2005;82(5):1082-9.

15. Lin HS, Watts JN, Peel NM, et al. Frailty and post-operative outcomes in older surgical patients: a systematic review. BMC Geriatr. 2016;16(1):157.
16. Veiga-Gil L, Pueyo J, López-Olaondo L. Postoperative nausea and vomiting: physiopathology, risk factors, prophylaxis and treatment. Rev Esp Anestesiol Reanim. 2017;64(4):223-32.
17. Lawson RM, Doshi MK, Barton JR, et al. The effect of unselected post-operative nutritional supplementation on nutritional status and clinical outcome of orthopaedic patients. Clin Nutr. 2003;22(1):39-46.
18. Lawson RM, Doshi MK, Ingoe LE, et al. Compliance of orthopaedic patients with postoperative oral nutritional supplementation. Clin Nutr. 2000;19(3):171-5.
19. BAPEN. Nutrition Screening Surveys in Hospitals in the UK, 2007-2011. https://www.bapen.org.uk/pdfs/nsw/bapen-nsw-uk.pdf access date 15.07.2020
20. Kondrup J, Rasmussen HH, Hamberg O, et al. Ad Hoc ESPEN Working Group. Nutritional risk screening (NRS 2002): a new method based on an analysis of controlled clinical trials. Clin Nutr. 2003;22(3):321-36.
21. Macfie D, Zadeh RA, Andrews M, et al. Perioperative multimodal optimisation in patients undergoing surgery for fractured neck of femur. Surgeon. 2012;10(2):90-4.
22. Köse O, Budak S, Aydemir H, et al. Radikal Sistektomi Yapılan Hastalarda Preoperatif Oral Destek Nutrisyonun Cerrahi İyileşmeye Etkisi. The Cystoscope. 2014;136-40.
23. Stratton RJ, Elia M. Who benefits from nutritional support: what is the evidence? Eur J Gastroenterol Hepatol. 2007;19:353-8.
24. Bruce D, Laurance I, McGuiness M, et al. Nutritional supplements after hip fracture: poor compliance limits effectiveness. Clin Nutr. 2003;22(5):497-500.
25. Staudacher HM, Irving PM, Lomer MCE, et al. The challenges of control groups, placebos and blinding in clinical trials of dietary interventions. Proc Nutr Soc. 2017;76(3):203-12.
26. Barrimore SE, Rapchuk IL, Pulle RC, et al. Even preoperative carbohydrate loading is too hard? Why RCT's should not be considered the gold standard for nutrition research in acute hip fracture: results of a feasibility study. Int J Clin Trials. 2019;6(3):89-95.
27. Feinberg J, Nielsen EE, Korang SK, et al. Nutrition support in hospitalised adults at nutritional risk. Cochrane Database Syst Rev. 2017;5(5):CD011598.