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A Novel Framework for Texture-Modified Diets is Associated with ADL Improvement in Older Adult Patients

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Abstract

Aims: To test our hypothesis that swallowing capacity evaluated at admission is associated with poorly improving Activities of Daily Living (ADL) in older adult inpatients and that they must be target of earlier nutritional intervention including nutritional counseling conducted by registered dietitians.

Methods: Recruited subjects were consecutive all inpatients aged ≥ 65 years old admitted to a single hospital met without exclusion criteria. After dividing included subjects by with the International Dysphagia Diet Standardization Initiative Functional Diet Scale (IDDSI-FDS) score <7 (low) *vs.* ≥ 7 (high) at admission, all collected data was compared to draw which patients must be target of intensive nutritional intervention to achieve relevant outcome.

Results: 95 patients out of 167 were included with low- *vs.* high-IDDSI score (n=24 *vs.* 71, respectively). FOIS and IDDSI score in low-group showed significantly smaller ADL change measured by differences between Barthel Index (BI) between admission and discharge compared with in high-group (0 *vs.* 15, respectively: p=0.004), instead nutritional management added with parenteral nutrition. The logistic regression analysis showed that odds ratio of IDDSI-FDS for BI improvement was 2.061 (95% CI: 1.124-3.777: p=0.019).

Conclusion: The IDDSI score seems have an association of swallowing dysfunction followed by smaller BI improvement in older adult patient's ≥ 65 years old who must be target of intensive nutritional intervention to prevent poor outcome.

Keywords: Functional Oral Intake Scale (FOIS); The International Dysphagia Diet Standardization Initiative Functional Diet Scale (IDDSI-FDS); Older adult; Swallowing difficulty

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Introduction

The Functional Oral Intake Scale (FOIS) was developed in 2005 as a tool with very good reliability, validity, and sensitivity to change to objectively determine and monitor the range of oral intake of patients with neurogenic dysphagia [1,2]. The feeding textures of non-oral are subsumed in levels 1 to 3, whereas different ranges of oral feeding are included in levels 4 to 7. The subjects to utilize FOIS varies widely in neuromuscular disorders from neural degenerative diseases, such as amyotrophic lateral sclerosis, Parkinson's disease, Alzheimer typed-dementia, to brain injury and cerebral vascular pathologies based on hypertension and atherosclerosis [3-5]. More than a decade later, IDDSI-scale ver.2 was developed by body of International Dysphagia Diet Standardization Initiative in 2019. Behind this development, exists global background in which aging society become common among whole country would wide not only developed countries, but also developing countries. With symbolic study conducted in "Global Burden of Disease (GBD) Study" which began in 1990 and spread worldwide as a collaboration of 3,600 researchers from 145 countries and is a comprehensive regional and global research program of disease burden that assesses mortality and disability from major diseases, injuries, and risk factors [6]. In the study of GBD discussing 365 diseases and injuries in 204 countries and territories [7], three out of

Table 1: The collected data in six categories from the electric medical note of recruited subjects.

	Category	Included Data	Timing of Measurement		
			admission	First 3 days after admission	discharge
1	Demographics	Age, sex, and Charlson comorbidity index, living place before admission or discharge: home, nursing home, and hospital	○		○
2	Body size parameters	Height, body weight (BW), body mass index (BMI), difference of BW between admission (BW ad) and discharge (BW dis) (kg) and its change percentage calculated by the equation of [BW dis – BW ad] × 100/ [BW ad] (%)	○		○
3	Physical daily activity	Barthel index, evaluated at admission (BI ad) and discharge (BI dis)	○		○
4	Laboratory data	Serum albumin concentration (Alb), total lymphocyte count (TLC), C-reactive protein (CRP)	○		○
5	Nutritional parameters	Average daily nutritional intakes of energy (kcal/kg of BW) and protein (grams/kg of BW)		○	
6	Dietary texture measurements	Functional Oral Intake Scale (FOIS),The International Dysphagia Diet Standardization Initiative Functional Diet Scale (IDDSI-FDS)	○		○
7	Outcome parameters	difference of BI (Δ BI) (calculated by [BI dis – BI ad]), length of stay in hospital	○		○

Abbreviations: BI: Barthel Index; BMI: Body Mass Index; BW: Body Weight; CCI: Charlson Comorbidity Index; CRP: C-Reactive Protein; FOIS: Functional Oral Intake Scale; IDDSI: International Dysphagia Diet Standardization Initiative; RD: Registered Dietitian; TLC: Total Lymphocyte Count; WBC: White Blood Cell

commonest five diseases in older adults aged 75 years and older are stroke at second, Alzheimer disease and diabetes at 4 and 5 rank, respectively. These three seems related to intra-cerebral lesions and to some extent related to swallowing difficulties. Under these global aging circumstances, we hypothesized that swallowing disability is impacting factor on deciding outcome in older adult inpatients. To exam this, we designed the study and performed in the retrospective style.

Aims

To test our hypothesis that swallowing capacity evaluated at admission is associated with poorly improving Activities of Daily Living (ADL) in older adult patients (pts) and those they must be target of earlier nutritional intervention including nutritional counseling conducted by registered dietitians.

Methods

Recruited subjects

This is the retrospective chart review study in a single hospital of consecutive all admitted pts aged 65 years old and older during 30 days in September, 2019. Exclusion criteria were the follows: 1) the length of admission was shorter than 4 days, 2) pts who did not have diet during the first 3 days, 3) pts who admitted for ophthalmologic purposes, 4) pts who admitted for not medical but social purposes. This study was approved by the ethic committee of the studied hospital (The approval number: 2021-001).

Collected data

All collected data from chart of individual pts using electric notes in six categories shown in Table 1.

Methods

After dividing all included subjects according to IDDSI-FDS (IDDSI) score evaluated at admission into two groups, <7 (low-) *vs.* 7 ≤ (high-group), all collected data in two groups were individually compared to draw which parameters were independently associated with ADL improvement. In addition, the logistic regression analysis was performed to have Odds Ratio (OR) with statistical probability for determinants to predict ADL outcome.

Statistical analysis

As this study was conducted retrospectively, texture-modified diet is hypothesized to be associated with impairment of physical activities during hospitalization were our main concern. Thus, all included pts were divided into two groups by IDDSI score, pts with IDDSI score 7 ≤ *vs.* < 7 evaluated at admission. These two groups were designated high and low IDDSI-group, respectively. Then, we searched which factors might have impact on poor outcomes such as worse ADL measured by BI or length of stay in hospital. The measured data were expressed in medium (25%ile, 75%ile) or pts number (%). The statistical analyses were conducted using Mann-Whitney U test for non-parametric valuables and chi-square test or Fisher's exact test were applied for categorized valuables. To evaluate the impact of IDDSI-FDS on physical functional outcome expressed by BI, we used multivariate logistic regression model adjusted for age, Alb, CCI, BMI at admission, and scoring chart for the IDDSI-FDS, separately. The 95% Confidence Interval (CI) reported for the logistic regression Odds Ratios (ORs). All statistical tests were analyzed by SPSS Statistics version 22 (IBM, Armonk, NY) and $p<0.05$ was identified significant difference. This study was approved by institutional ethical board to be conducted (the approval number was 21-01).

Results

The recruited pts counted 167, and 72 cases were excluded according to exclusion criteria. The remaining 95 cases were proceeded to analysis and divided into two groups with IDDSI score ≥ 7 (high) *vs.* <7 (low-IDDSI group) (n=71 *vs.* 24, respectively) (Table 2). Their baseline demographics between two groups showed that. Low-IDDSI group had smaller BMI, lower Alb, and BI at admission, and poor swallowing capacity expressed by FOIS and IDDSI-Functional Diet Scale. Instead of nutritional efforts on low group of additional parenteral nutritional deliveries in energy and protein (expressed in kcal or grams/kg of actual BW/day) were significantly larger whereas enteral or oral nutritional were similar between two groups, swallowing dysfunction evaluated remained poor at discharge from hospitalization. In addition, ΔBI in low-group had a significantly smaller than in high-group (0 *vs.* 15, respectively: p=0.004) (Table 3). From these observational results mainly on patients with swallowing dysfunction must be more intensive nutritional intervention,

Table 2: Comparison of data on admission in two groups divided by scoring chart for the IDDSI Functional Diet Scale: group with score <7 *vs.* >= 7.

	Total (n=95)	<7 (n=24)	≧7 (n=71)	P value
Demographic parameters				
Age, years	84 (78, 89)	91 (83, 93)	83 (75, 86)	<0.001
Males, n (%)	33 (35)	10 (42)	23 (32)	0.410
Height at admission, cm	151 (147, 160)	150 (142, 161)	153 (148, 160)	0.128
Body weight at admission, kg	47.8 (41.2, 55.4)	41.1 (35.3, 48.5)	51.3 (43.0, 56.7)	<0.001
BMI, kg/m^2	20.6 (17.6, 22.8)	17.8 (16.2, 20.5)	21.5 (18.8, 24.2)	<0.001
CCI	1 (1, 3)	2 (1, 4)	1 (0, 2)	0.007
Cognitive impairment, n (%)	14 (15)	7 (29)	7 (10)	0.029
Hemiplegia, n (%)	6 (6)	4 (17)	2 (3)	0.034
Malignancy without metastasis, n (%)	17 (18)	8 (33)	9 (13)	0.028
Department				
Internal medicine, n (%)	35 (37)	12 (50)	23 (33)	0.122
Surgery, n (%)	6 (6)	1 (4)	5 (7)	0.524
Orthopedics, n (%)	52 (55)	10 (42)	42 (59)	0.137
Neurosurgery, n (%)	2 (2)	1 (4)	1 (1)	0.443
Laboratory data ay admission				
Alb, g/dL	3.4 (3.0, 4.0)	3.1 (2.4, 3.2)	3.6 (3.2, 4.1)	<0.001
WBC, × 10²/μ	75.2 (58.4, 95.0)	78.4 (61.5, 100.5)	71.0 (57.8, 92.9)	0.463
TLC, %	15.5 (10.7, 23.4)	13.1 (9.9, 21.0)	17.8 (10.9, 24.6)	0.272
CRP, mg/dL	0.88 (0.13, 4.33)	3.16 (0.27, 5.13)	0.64 (0.07, 2.99)	0.058
Living place before admission				
Home, n (%)	60 (63)	9 (38)	51 (72)	0.003
Other hospital, n (%)	16 (17)	3 (12)	13 (18)	0.379
Nursing home, n (%)	19 (20)	12 (50)	7 (10)	<0.001
BI at admission				
Help needed with feeding	10 (5, 10)	5 (0, 5)	10 (5, 10)	<0.001
Help needed with transfers	10 (0, 10)	0 (0, 10)	10 (0, 15)	0.003
Help needed with grooming	0 (0, 5)	0 (0, 0)	0 (0, 5)	0.001
Help needed with toilet use	5 (0, 5)	0 (0, 5)	5 (0, 10)	0.003
Help needed with bathing	0 (0, 0)	0 (0, 0)	0 (0, 0)	0.119
Help needed with walking	0 (0, 10)	0 (0, 0)	5 (0, 10)	0.005
Help needed with climbing stairs	0 (0, 5)	0 (0, 0)	0 (0, 5)	0.029
Help needed with dressing	5 (0, 10)	0 (0, 5)	5 (0, 10)	0.006
Presence of fecal incontinence	5 (0, 10)	0 (0, 5)	10 (0, 10)	<0.001
Presence of urinary incontinence	5 (0, 10)	0 (0, 5)	10 (0, 10)	<0.001
Total score	45 (10, 70)	8 (0, 41)	55 (15, 80)	<0.001
Nutritional Intakes during the first 3 days				
Energy intake via PN (kcal/day)	0 (0, 54)	0 (0, 333)	0 (0, 0)	0.005
Energy intake via oral route (kcal/day)	1202 (798, 1373)	931 (610, 1284)	1220 (834, 1404)	0.089
Total energy intake (kcal/day)	1210 (870, 1408)	1010 (844, 1373)	1222 (870, 1431)	0.464
Total energy intake per body weight (kcal/day/kg)	24.4 (18.6, 29.4)	26.3 (20.7, 32.9)	24.0 (16.7, 28.9)	0.120
Amino acid intake via PN (g/day)	0.0 (0.0, 0.0)	0.0 (0.0, 11.3)	0.0 (0.0, 0.0)	0.002
Amino acid intake via oral route (g/day)	44.8 (29.0, 50.4)	35.4 (22.0, 45.8)	45.8 (30.4, 51.0)	0.013
Total protein intake (g/day)	45.0 (29.7, 50.8)	39.7 (29.1, 47.1)	45.8 (30.4, 51.2)	0.163
Total protein intake per body weight (g/day/kg)	0.9 (0.7, 1.1)	1.0 (0.7, 1.1)	0.9 (0.7, 1.0)	0.255

Nutritional management				
Nutritional counselling by RD, n (%)	63 (66)	20 (83)	43 (61)	0.041
Drugs number	6 (4, 9)	5 (3, 6)	6 (4, 9)	0.062
Dysphagia at admission				
FOIS	6 (6, 7)	5 (5, 5)	7 (6, 7)	<0.001
IDDSI framework score for foods	6 (6, 7)	5 (5, 6)	7 (6, 7)	<0.001
IDDSI framework score for liquids	0 (0, 0)	2 (0, 2)	0 (0, 0)	<0.001
Scoring chart for the IDDSI Functional Diet Scale	7 (6, 8)	5 (4, 6)	8 (7, 8)	<0.001

Data are expressed in medium (25% tile, 75% tile)
IDDSI Functional Diet Scale: group with <7 *vs.* >=7: Mann - Whitney's U test and the chi - square or Fisher's exact test for categorical variables.
Abbreviations: BMI: Body Mass Index; CCI: Charlson Comorbidity Index; WBC: White Blood Cell; TLC: Total Lymphocyte Count; CRP: C-Reactive Protein; BI: Barthel Index; FOIS: Functional Oral Intake Scale; IDDSI: International Dysphagia Diet Standardization Initiative; RD: Registered Dietitian

Table 3: Comparison of outcome data in two groups divided by scoring chart for the IDDSI Functional Diet Scale: Group with score <7 *vs.* >=7.

	Total (n=95)	**<7 (n=24)**	**≧7 (n=71)**	**P value**
Anthropometric parameters at discharge				
Body weight at discharge, kg	47.1 (39.0, 54.5)	39.4 (35.2, 48.8)	49.8 (40.9, 56.4)	<0.001
BMI at discharge, kg/m^2	20.0 (17.4, 23.3)	18.3 (15.4, 20.2)	20.9 (18.1, 23.8)	<0.001
Change of body weight, kg	-0.8 (-2.3, 0.1)	-1.7 (-2.8, 0.0)	-0.8 (-2.2, 0.3)	0.361
Change of body weight,%	-1.6 (-4.9, 0.2)	-3.7 (-8.1, 0.0)	-1.5 (-4.6, 0.5)	0.191
Living place after discharge				
Home, n (%)	50 (53)	5 (21)	45 (63)	<0.001
Hospital, n (%)	18 (19)	7 (29)	11 (16)	0.121
Nursing home, n (%)	27 (28)	12 (50)	15 (21)	0.007
BI at discharge				
Help needed with feeding	10 (5, 10)	5 (0, 10)	10 (10, 10)	<0.001
Help needed with transfers	10 (10, 15)	10 (1, 10)	15 (10, 15)	<0.001
Help needed with grooming	5 (0, 5)	0 (0, 0)	5 (0, 5)	<0.001
Help needed with toilet use	10 (0, 10)	0 (0, 5)	10 (5, 10)	<0.001
Help needed with bathing	0 (0, 5)	0 (0, 0)	0 (0, 5)	0.001
Help needed with walking	10 (0, 15)	0 (0, 4)	15 (10, 15)	<0.001
Help needed with climbing stairs	5 (0, 5)	0 (0, 0)	5 (0, 10)	<0.001
Help needed with dressing	10 (0, 10)	0 (0, 5)	10 (5, 10)	<0.001
Presence of fecal incontinence	10 (0, 10)	0 (0, 5)	10 (10, 10)	<0.001
Presence of urinary incontinence	10 (0, 10)	0 (0, 5)	10 (10, 10)	<0.001
Total score	75 (15, 95)	13 (5, 49)	90 (65, 95)	<0.001
Changes of BI				
ΔHelp needed with feeding	0 (0, 0)	0 (0, 4)	0 (0, 0)	0.317
ΔHelp needed with transfers	0 (0, 5)	0 (0, 5)	5 (0, 5)	0.226
ΔHelp needed with grooming	0 (0, 5)	0 (0, 0)	0 (0, 5)	0.047
ΔHelp needed with toilet use	0 (0, 5)	0 (0, 0)	0 (0, 5)	0.006
ΔHelp needed with bathing	0 (0, 0)	0 (0, 0)	0 (0, 5)	0.030
ΔHelp needed with walking	0 (0, 10)	0 (0, 0)	5 (0, 10)	0.002
ΔHelp needed with climbing stairs	0 (0, 5)	0 (0, 0)	0 (0, 5)	0.003
ΔHelp needed with dressing	0 (0, 5)	0 (0, 0)	0 (0, 5)	0.001
ΔPresence of fecal incontinence	0 (0, 0)	0 (0, 0)	0 (0, 5)	0.168
ΔPresence of urinary incontinence	0 (0, 0)	0 (0, 0)	0 (0, 0)	0.064
ΔTotal score	10 (0, 35)	0 (0, 9)	15 (0, 45)	0.004
Dysphagia at discharge				
FOIS	6 (6, 7)	5 (5, 6)	7 (6, 7)	<0.001

IDDSI framework score for foods	6 (6, 7)	5 (5, 6)	6 (6, 7)	<0.001
IDDSI framework score for liquids	0 (0, 0)	2 (0, 2)	0 (0, 0)	<0.001
Scoring chart for the IDDSI Functional Diet Scale I	7 (6, 8)	5 (4, 6)	7 (7, 8)	<0.001
The length of stay in hospital	41 (23, 55)	48 (26, 62)	38 (23, 52)	0.128

Data are expressed in medium (25% tile, 75% tile)
IDDSI Functional Diet Scale: group with < 7 vs. >=7: Mann - Whitney's U test and the chi-square or Fisher's exact test for categorical variables.
Abbreviations: BI: Barthel Index; FOIS: Functional Oral Intake Scale; IDDSI: International Dysphagia Diet Standardization Initiative

Table 4: Results of the logistic regression analysis for confounding factors on ADL changes.

	OR (95% CI)	P Value
Age	0.973 (0.885-1.070)	0.569
Alb	0.881 (0.323-2.402)	0.805
CCI	0.869 (0.567-1.332)	0.519
BMI at admission	0.809 (0.667-0.981)	0.031
Scoring chart for the IDDSI Functional Diet Scale	1.952 (1.085-3.513)	0.026

Adjusted for age, Alb, CCI, BMI at admission, and scoring chart for the IDDSI-FDS, separately.
IDDSI Functional Diet Scale : group with < 7 vs. >=7: Mann - Whitney's U test and the chi-square or Fisher's exact test for categorical variables.
Abbreviations: Alb: Serum Albumin Concentration; BMI: Body Mass Index; CCI: Charlson Comorbidity Index; CI: Confidence Interval; FOIS: Functional Oral Intake Scale; IDDSI: International Dysphagia Diet Standardization Initiative; OR: Odds Ratio

including enteral management and nutritional counseling conducted by registered dietitians. Moreover, the logistic regression analysis also showed that OR of IDDSI-FDS for BI improvement was 2.061 (95% CIs: 1.124-3.777: p=0.019) (Table 4).

Discussion

Swallowing dysfunction as predictor of poor outcome and target of intensive nutritional intervention

Our study has shown that older patients with poor swallowing capacity evaluated at admission by FOIS and IDDSI score seemed predictor of poorly improving of ADL instead of ordinary nutritional management and additional parenteral nutrition. Comparing energy intake amount of two groups during the first three days of hospitalization, low group did not receive less under nutritional management regardless less thick texture of hospital diets. From these, it might notice us at least two things. First, FOIS and IDDSI-FDS score are utilized as assessment tool to measure swallowing capacity. FOIS has been validated and reported available in clinical settings [8,9]. Differently from FOIS, IDDSI-scale ver.2 which was developed by body of International Dysphagia Diet Standardization Initiative in 2019, has not been fully studied for its clinical feasibility and validity because of its shortness of time from development. Comparing of IDDSI-FDS with FOIS, whereas differences of IDDIS and FOIS scores measured at admission and discharge seemed similar from our results, our findings exist in that IDDSI has advantage of easiness to use. Second, regardless nutritional management added with parenteral nutrition on low-IDDSI group, they did not achieve improvement of ADL or shorten length of stay in hospital compared with high-group. From these results, two nutritional suggestions might exist. One is that patients with low IDDSI-score <7 points must be target of intensive nutritional management. Another is that more energy and/or protein amount must be delivered as these patients had similar energy and protein amount compared with high-IDDSI patients. Further investigations must be necessary to confirm how much energy and protein to improve outcome of patients with low IDDSI score at admission. However, from aspect of assessment tool of swallowing capacity, this study might be the first to report that IDDSI is useful assessment measure in older adult patients.

Limitations of this Study

There are three limitations to warrant in this study. First, diagnosing sarcopenia did not conducted. The phenomenon hidden behind swallowing dysphagia shown in patients with low-IDDSI score might be sarcopenia because they show body weight loss during hospitalization more compared with patients with high-IDDSI score. However, we did not measure patients with sarcopenia criteria [10]. Sever dysphagia in cancer patients have been associated with skeletal muscle mass reduction and poor oral food intake with low BI score [11]. This article reported similar what we did in term of an association of swallowing dysfunction and body weight loss. From aspect of sarcopenia, our subjects seem sarcopenic although it was not diagnosed. The further studied are warranted to make confidential findings. Second, the validation study for IDDSI measurement must be necessary to utilize it as an assessment tool in this study. IDDSI functional food scale has been developed by officially approved body. However, this scale has poorly studied in its validity. Third, the number of subjects must be scare and the study fashion might be not retrospective but prospective to make conclusive findings. As retrospective study has fatality to have limitation in potential bias of demographic at baseline unless propensity method is applied.

Conclusion

The IDDSI score seems have an association of swallowing dysfunction followed by smaller BI improvement in older adult patient's ≥ 65 years old who must be target of intensive nutritional intervention to prevent poor outcome.

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