Evaluation of the Benefits of Enteral Nutrition in Long-Term Care Elderly Patients

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Background: Demented patients may refuse to eat as they come closer to the end of their lives. We evaluated the effectiveness of enteral nutrition in the improvement of survival and nutritional and functional status in very dependent and demented long-term care (LTC) elderly patients and its correlation with the nutritional parameters.

Material and Methods: Fifty-seven elderly patients, aged 60 years and older, who received nutrition by the enteral route (enteral nutrition group, ENG), were compared with 110 age-, sex-, comorbibity-, cognitive-, and dependent-matched subjects (control group, CG). Indications for enteral nutrition, type of tube; weight status subsequent to enteral nutrition; cognitive, functional, and pressure sore status; and complete clinical, complete blood count, and biochemical profile were recorded for each subject on initiation and conclusion of the study.

Results: Enteral nutrition was associated with improvement in blood count (hemoglobin and lymphocyte count), in renal function tests and electrolytes (BUN, creatinine, BUN/creatinine ratio, sodium and potassium), hydration status, serum osmolarity, and in serum proteins (total protein, albumin, and transferrin), but not in serum cholesterol and CRP levels. Decline in functional and in cognitive status was higher in CG than in ENG (Δ changes; respectively $P = .24$ and $P < .001$). ENG had a higher Norton scale than CG (Δ changes; $P < .001$). Mortality rate was higher in ENG (42%) than in CG (27%, $P > .05$). Complication rate related to nutrition was higher in ENG than in CG (61% and 34%, respectively; $P < .001$).

Conclusion: Enteral nutrition does not have an advantage over oral nutrition in prolonging life or preventing pressure sore development in an LTC setting. **(J Am Med Dir Assoc 2008; 9: 657–662)**

Keywords: Elderly; enteral feeding; nasogastric tube; percutaneous endoscopic gastrostomy; long-term care

Malnutrition and involuntary weight loss are common in long-term care facilities. Malnutrition occurs in 1% to 15% of ambulatory outpatients, 25% to 60% of institutionalized patients, 35% to 65% of hospitalized elderly patients and in 29% of new admissions to a long-term care geriatric hospital.[1–7] In a study of 156 nursing home residents, 15% to 21% of them lost more than 2.3 kg over a 3- to 6-month period. Malnutrition is associated with higher comorbidity, secondary to reduced function and impaired immunity, leading to pneumonia, sepsis, exacerbation of cognitive and mood disorders, reduction in quality of life, delayed wound healing, pressure sore development, and finally death.[1,8,9]

Malnutrition is often unrecognized and left untreated.[3] More than 216,000 feeding tubes were placed in 2000, up from 15,000 tubes in 1989 with as many as 10% of institutionalized older patients being tube-fed.[10]

While the guidelines of the American Gastroenterological Association for the use of enteral nutrition recommend nasogastric or nasoenteric tubes (NGT) for short-term feeding,[11] the use of percutaneous endoscopic gastrostomy (PEG) is recommended for tube feeding for periods longer than 30 days. However, if a patient tolerates NGT feeding, PEG is not necessarily indicated.

The purpose of this study was to examine whether enteral nutrition is an effective tool in improving survival, nutritional and functional status in very dependent and demented elderly patients, and its correlation with nutritional parameters.

MATERIALS AND METHODS

Design and Setting

This was a prospective study, conducted between March 1, 2001, and December 31, 2002, in a long-stay geriatric medical

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center with 650 inpatient beds, comprising long-term care wards in Frieda Shiff Warburg Geriatric Medical Center in Netanya, Israel.

Subjects

Patients from 3 psychogeriatric wards for terminal (advanced vascular and degenerative type of dementia) elderly patients were included in the study. Informed consent was obtained from surrogates. The indication for enteral feeding was determined on clinical grounds. All enteral nutrition group (ENG) patients had severe cognitive impairment and had several potential indications for initiation of the enteral nutrition. The most frequent indications were weight loss (40%, 23/57), stroke with impaired oral intake (32%, 18/57), refusal to eat (28%, 16/57), vegetative state (12%, 7/57), advanced stage of Parkinson's disease (9%, 5/57), and malignancy (5%, 3/57). The study was approved by the local ethics committee.

All patients completed periodic clinical and nutritional assessment. Patients were randomized to the control group (CG), who received oral nutritional support, and ENG. CG included 110 patients. Despite that throughout the study period 76% (84/110) of CG patients received oral supplementation for more than 2 months, we have not performed additional separation of the patients. ENG included 57 severely demented and dependent patients; 74% (42/57) of ENG patients received nutrition through NGT and the remainder by PEG. The demographic and clinic characteristics of the patients are shown in Table 1.

Assessment

The assessment included (1) demographic data: age, gender, and complete list of all primary and secondary diagnoses and drug treatment; (2) indications for enteral nutrition; (3) data on tube insertion; (4) type of tube; (5) weight, subsequent to enteral nutrition; (6) cognitive, functional status; (7) pressure sore status; (8) complete routine clinical and laboratory data; and (9) anthropometric measurements.

A body mass index (BMI) of 21 kg/m^2 was considered as a marker of malnutrition. Cognitive evaluation was performed using the Mini Mental State Examination (MMSE)[12]; functional status using the Katz index of Activities of Daily Living (ADL).[13] The Katz index of ADL was scored on a 3-level scale (0 = totally dependent, 1 = partial help needed, 2 = totally independent) with total scores ranging from 0 (totally dependent) to 12 (independent). The pressure sore risk status was assessed by the Norton scale.[14]

Our detailed laboratory investigation and nutritional and anthropometric assessment was performed upon the initiation of the study, as a baseline, and every 6 months thereafter. Major clinical events during the study included pneumonia, pressure sores, re-feeding syndrome, and cases of fatality.

Laboratory data included complete blood count, biochemistry profile including serum proteins (total protein, albumin, transferrin, and C reactive protein [CRP]); renal function tests and electrolytes (blood urea nitrogen [BUN], creatinine [Cr], sodium and potassium); and total cholesterol, iron, cobalamin, and folic acid. Elevated BUN/Cr ratio was considered for values equal to or greater than 25.

Calculation of the plasma osmolarity was calculated with the following formula:

$$[2 \times (Na + K) + (glucose/18) + BUN/28].$$

The free water deficit was calculated with the following formula[15]:

Water deficit = normal total body water − current total body water;
Normal total body water in liter = (0.5 × body water [kg]);
Current total body water = (normal serum sodium in mEq/L) × (normal total body water)/(measured serum sodium in mEq/L).

Blood samples were drawn with patients in a recumbent position. The laboratory investigation was performed using the COBAS INTEGRA 400 (Roche Diagnostics Corporation, Indianapolis, IN) and blood count on CELL-DYN 1600 (Abbott Diagnostics Division, Santa Clara, CA).

The normal value of CRP was less than 5 mg/L and measured by Latex with a sensitivity of 0.07 mg/L.

Interventions

The enteral tube feeding used consisted of the medical food: Osmolite H.N. (Abbott Laboratories, 45 g/1l protein, 1057 Cal/1l) and Jevity H.N. (Abbott Laboratories, 41.8 g/1l, 1057 Cal/1l), usually in 4 feedings varying from 1340 to 2210 calories per day. The most frequently prescribed diet (non tube fed) contains 1800 to 2000 calories, 2 to 3 g sodium, and 80 g protein. Additionally, Ensure (13 g/1l protein, 1522 Cal/1l, Abbott Laboratories, Kiryat-Atidim, Israel) was used in the CG patients according to recommendation of dietitians.

Table 1. *General Characteristics of Patients*

	CG n = 110 (%)	ENG n = 57 (%)	*P*
Age, y	80.6 ± 8.96	79.35 ± 10.45	>.05
Female	79 (72)	47 (82)	>.05
Comorbidity	6.55 ± 2.66	5.79 ± 2.62	>.05
Cardiovascular disease	78 (71)	44 (77)	>.05
Stroke	46 (42)	32 (56)	>.05
Chronic renal disease	32 (29)	16 (28)	>.05
Pulmonary disease	25 (23)	13 (23)	>.05
Diabetes mellitus	23 (21)	18 (32)	>.05
Mean number of drugs per patients	7.45 ± 2.96	6.81 ± 2.16	>.05
BMI			
<21 (%)	18 (16)	17 (30)	.043*
>30 (%)	8 (7)	7 (12)	>.05
Pressure sores (%)	13 (12)	15 (26)	.017†

CG, control group; ENG, enteral nutrition group; BADL, Basic Activity of daily living; MMSE, Mini Mental State Examination; BMI, body mass index.
* $\chi^2 = 4.11$.
† $\chi^2 = 5.65$.

The most frequently used enteral tube feeding was Osmolite H.N solution (81%, 46/57).

Statistical Analysis

Statistical analysis was performed using SPSS 11.5. Laboratory data (SPSS, Inc., Chicago, IL) are presented as mean ± SD. In all cases normality was assessed by the Kruskal-Wallis test (between studied groups), and by Kolmogorov-Smirnov test (inside of the groups). The difference in the measurements between the first and last measurements (Delta [Δ] change) was calculated and used in analysis between groups on conclusion. Pearson's correlation was performed in analysis for correlation between CRP and hematocrit, lymphocyte count, albumin, transferring, and cholesterol. Statistical analysis was accomplished by chi-square test. The *P* values at less than the .05 level were considered significant. A chi-square test of 3.84 with 1 degree of freedom corresponds to a *P* value of .05. The Yates correction for chi-square was performed if any of the cells in a 2 × 2 table was less than 5, or if the summary of the table was less than 30. Survival analysis was performed using the Kaplan-Meier method. The comparison of 2 survival distributions was performed by Mantel-Cox log-rank test.

RESULTS

The mean age of the study population was 80.17 years; female gender was predominant (75%). The patients in both groups had similar medical backgrounds and diseases, except for a higher prevalence of patients with underweight and presence of pressure sores in ENG than in CG (30% versus 16%, $P = .043$, $\chi^2 = 4.11$, and 26% versus 12%, $P = .017$, $\chi^2 = 5.65$; respectively) (Table 1).

All ENG group patients received food only by enteral route. The enteral nutrition was administered 4 times daily. The mean volume of enteral feeding including water per 24 hours was 1940 milliliters (range: 1520–2300) per patient. The mean number of calories provided per 24 hours per patient was 1582 calories (range: 1197–2210).

Generally, patients from the CG group ate independently. Nevertheless, 76% (84/110) of them needed feeding assistance at least once, and received oral supplementation by Ensure for more than 2 months. The mean duration of oral supplementation was 68 days (range: 5–120) with the mean intake being 378 (range: 300–610) calories per day per patient (range: 300–610). These patients who received feeding oral supplementation needed it due to a medical distress or a refusal to eat.

On baseline study, the number of dehydrated patients in ENG was twofold greater than in CG (26% versus 13%, $P = .028$, $\chi^2 = 4.83$), with mean water deficits of 1.85 L and 1.44 L respectively ($P = .038$). In addition they had higher serum CRP levels, lower levels of serum protein (total protein, albumin, and transferrin), cholesterol, and higher BUN/creatinine ratio (Table 2). On conclusion of the study period improvements in laboratory data were reported in ENG in comparison to CG (Table 2). Decline in cognitive and functional status were higher in CG than in ENG (Δ changes; respectively $P = .24$ and $P < .001$). ENG had a higher Norton scale than CG (Δ changes; $P < .001$).

Negative correlation between CRP and lymphocyte count, albumin, transferring, and cholesterol blood levels was shown in both studied groups (Table 3).

Sixty-one percent of patients in the ENG group experienced at least one major complication or symptom related to

Table 2. *Laboratory Value on Baseline and on Conclusion*

	Units	Baseline			On Conclusion		
		CG	ENG		CG	ENG	*P*
Haemoglobin	g/dL	11.72 ± 1.58	11.62 ± 1.36	>.05	11.88 ± 0.89	11.76 ± 0.65	>.05
Lymphocytes	× 10^3mm^2	2.55 ± 0.76	2.27 ± 0.75	>.05	2.40 ± 0.56	2.39 ± 0.64	>.05
Sodium	mmol/L	138.64 ± 6.20	140.21 ± 5.88	.042	140.33 ± 5.46	136.98 ± 5.85	.003
Potassium	mmol/L	3.93 ± 0.58	4.18 ± 0.59	.012	4.13 ± 0.48	4.01 ± 0.48	>.05
Urea nitrogen	mmol/L	14.53 ± 7.71	19.04 ± 10.55	.004	14.76–0.60	11.75–12.29	<.001
Creatinine	μmol/L	92.82 ± 25.64	93.70 ± 30.06	>.05	93.69–0.07	87.51–3.54	<.001
BUN/Cr ratio		15.40 ± 10.57	18.58 ± 8.72	.003	15.44–0.09	12.95–12.23	<.001
CRP	mg/L	4.49 ± 3.97	6.42 ± 3.80	<.001	4.93 ± 1.15	6.75 ± 1.26	<.001
Total protein	g/L	68.83 ± 6.04	66.42 ± 5.90	.007	68.03 ± 5.33	68.07 ± 5.24	>.05
Albumin	d/L	37.52 ± 4.43	33.93 ± 3.50	<.001	36.39 ± 2.82	37.40 ± 2.81	.043
Transferrin	mg/L	2.33 ± 0.66	2.00 ± .48	<.001	2.17 ± 0.68	2.08 ± 0.67	>.05
Total cholesterol	mmol/L	5.73 ± 1.17	4.47 ± 1.04	>.05	5.10 ± 0.58	4.45 ± 0.39	<.001
Vitamin B-12	pmol/L	169.47 ± 83.85	184.93 ± 124.06	>.05	157.74 ± 5.53	172.52 ± 8.84	<.001
Folic acid	nmol/L	4.73 ± 2.42	4.48 ± 2.01	>.05	4.65 ± 0.31	4.38 ± 0.23	<.001
Iron	μmol/L	35.95 ± 27.517	34.05 ± 16.10	>.05	34.29 ± 13.42	32.55 ± 8.36	>.05
Osmolarity plasma	mmol/kg	290.24 ± 11.66	292.18 ± 13.51	>.05	291.68 ± 10.39	290.04 ± 12.07	>.05
Water deficit	L	1.44 ± 0.54	1.85 ± 0.51	>.05	1.64 ± 0.84	1.46 ± 0.50	>.05
BMI	kg/m^2	23.94 ± 3.43	22.90 ± 3.14	>.05	23.23 ± 2.77	21.98 ± 1.67	.014
BADL		2.45 ± 0.97	0.75 ± 1.17	<.001	2.17 ± 0.47	0.57 ± 2.29	<.001
MMSE		6.41 ± 3.98	1.56 ± 1.87	<.001	4.50 ± 2.93	1.38 ± 1.21	<.001
Norton scale		10.53 ± 1.55	9.37 ± 1.08	<.001	10.57 ± 2.16	9.71 ± 1.25	.002

CG, control group; ENG, enteral nutrition group; BUN, blood urea nitrogen; CRP, C reactive protein; BADL, Basic Activity of daily living; MMSE, Mini Mental State Examination; BMI, body mass index.

Table 3. *Correlation between CRP and Laboratory Nutrition Markers Following the Study Period*

	Baseline				On Conclusion			
	CG		ENG		CG		ENG	
	r	P	r	P	r	P	r	P
Lymphocyte count	−0.396	<.001	−0.510	<.001	−0.408	<.001	−0.368	.035
Albumin	−0.358	<.001	−0.534	<.001	−0.370	.001	−0.387	.031
Transferrin	−0.327	<.001	−0.392	.003	−0.283	.011	−0.376	.031
Total cholesterol	−0.294	.002	−0.274	.039	−0.290	.009	−0.394	.002

CRP, C reactive protein; CG, control group; ENG, enteral nutrition group.

nutrition; in the CG this rate was only 34% ($P < .001$, $\chi^2 = 11.8$) of patients (Table 4).

Unlike that, our study was not randomized, in comparison of both studied groups following the study period, presence of advanced stage of pressure sores was higher in ENG than in CG patients. More ENG patients have had an increase in body weight by 5% and more than CG patients.

In conclusion, a total of 32% of the patients died (30 in the CG and 24 in the ENG), the Mantel-Cox log-rank test for equality of survival distributions between the groups was non-significant ($P > .05$).

DISCUSSION

Malnutrition and involuntary weight loss are common in elderly on long-term care. Malnutrition may be caused by several factors, including anorexia, insufficient oral intake (forgetting to eat), inability and apraxia of eating, or, less often by enhanced energy requirements due to hyperactivity. Artificial nutrition is an example of an invasive technology advancement, which has created new opportunities for improving patients' outcome, by lengthening their survival and quality of life.

The prevalence of malnutrition in our study (32%) was similar to that found in previous reports.[1,2,6,7] Most patients in our study had severe cognitive impairment. Barrett-Connor et al[16] found that weight loss precedes the onset of dementia and may itself be a risk factor for Alzheimer's disease.[9] Individuals with severe dementia often lose interest in food and drink, concomitant with a generalized indifference to their environment. In addition, they typically develop difficulty with the complex, coordinated process of swallowing. Carver and Dobson[17] reported that within 8 years of the onset of dementia of the Alzheimer type, 50% of patients need help in feeding or require artificial nutrition.

Callahan et al[18] reported that at least 40% of nursing home residents need feeding assistance. In our study, 76% of studied patients from the control group were in need of assistance with feeding and received nutritional supplementation for more than 2 months.

Ahronheim et al[19] reported the rate of tube feeding ranged from 7.5% to 40.1%, in a similar setting to ours, where 34% of studied patients received enteral nutrition.

In our study, all ENG patients had several potential indications for initiation of the enteral nutrition, and the main indications were weight loss (40%), stroke with impaired oral intake (32%), and refusal to eat (28%).

Decline in body weight is an important, independent marker of mortality risk for older adults. The effect of enteral nutrition on body weight is inconclusive. Previous studies[20,21] reported beneficial effect on body weight, but more recent studies showed no change.[18,22] Our results suggested a decrease in body weight.

Following the study, patients on enteral nutrition presented with remarkable improvement in the laboratory parameters. Despite the positive changes in nutritional laboratory markers, we did not find any benefits of enteral nutrition over usual oral intake in severely demented and severely dependent hospitalized elderly patients in the outcome measures: improvement of functional and cognitive status, predisposition to pressure sores and mortality.

Mitchell et al,[10] in a study of enteral nutrition in elderly patients with impaired cognition, found that tube feeding in prolonged advanced dementia with impaired eating or swallowing, showed the same mean survival time for those on enteral nutrition as those who did not have a feeding tube for active enteral nutrition. Similar results were reported in other studies.[18,22–24]

Callahan et al[18] in a prospective observational study of 159 patients aged 60 years and older who received enteral nutrition, found no improvement in functional status, nutritional status, or subjective health status after 1 year. Similar results were reported in other studies.[22–24] Weaver

Table 4. *Clinical Events and Weight Changes Following the Study*

	CG	ENG	P	χ^2
Pneumonia	26 (24)	27 (47)	.002	9.76
Pressure sores	15 (14)	17 (30)	.012	6.35
Stage I–II	13 (12)	9 (16)	>.05	
Stage III–IV	2 (2)	8 (14)	.005	7.9
Weight changes*				
Increase	5 (5)	21 (37)	<.001	26.39
Decrease	31 (28)	4 (7)	.005	7.9
Re-feeding syndrome		2 (4)		
Abscess in stoma site		2 (13)†		
Death	30 (27)	24 (42)	>.05	

CG, control group; ENG, enteral nutrition group.
* More than 5% in comparison to baseline.
† Calculation performed from patients on PEG route nutrition.

et al[25] in a study of the quality of life in patients being tube fed, found no improvement in their quality of life. In this study, adverse events related to nutrition support were higher in ENG (61%) than in CG (34%, $P < .001$). Also, enteral nutrition led to a greater prevalence of aspiration pneumonia and local complications such as irritation and inflammation of skin.

CRP is an acute-phase protein produced by the liver in a response to interleukin-6 (IL-6). We found that a baseline level of CRP was higher ($P < .001$) in the enteral nutrition group than in the control group, and was inversely related to hematocrit, lymphocyte count, albumin, transferring, and total cholesterol in both groups. During the study period, the significance of this relationship decreased in ENG and increased in CG. This inverse relationship between serum CRP and nutritional and hematological parameters is intriguing and provides evidence for the influence of chronic, low-grade inflammation as a contributing factor in functional decline and mortality in long-term older patients. Aging is associated with progressive increases in serum levels of glucocorticoids and catecholamines and decreased production of growth and sex hormones. These result in elevated concentrations of proinflammatory cytokines.[26] Ferrucci et al[27] reported that IL-6 and CRP play an important role in the pathogenesis of many diseases that are highly prevalent and are major contributors to functional decline, disability, and frailty. Leng et al[28] found an inverse relation between IL-6 and hemoglobin/ hematocrit in the frail group but not in a non-frail group. Therefore, CRP can also be considered as an important prognostic marker also for the initiation of tube feeding.

The use of feeding tubes is influenced by cultural, organizational, financial, demographic, emotional, racial, or religious decisional factors. The recent study by Braun et al[29] reported that use of PEG tubes for dementia patients increased from 1990 (1.2%), peaking in 1996 (1.8%), and subsequently decreased to baseline in 2001 (1.3%). In addition, the relative risk for PEG tube placement in African American dementia patients increased from 1.65 (in 1990) to 1.97 (in 2001). In another recent study by Clarfield et al,[30] the investigators found that 53% of demented patients in LTC departments in Israel were fed by tube, compared with 11% in Canada. A level of use in demented patients of only 4.7% was seen in non-Jewish Canadian institutions, whereas Jewish-affiliated hospitals in Canada exhibited an intermediate rate of 19.6%. In the United States,[31] a nationwide survey of 385,741 nursing home residents suffering from severe dementia revealed that 18% were fed through a tube. By state, rates varied from 3.8% in Nebraska to 44.8% in the District of Columbia.

CONCLUSION

Advanced aging is associated with low-level parameters of chronic inflammation. The parameters of chronic inflammation may be corrected with enteral nutrition support; nevertheless, this correction in very demented and dependent elderly patients has no impact on improvement in their functional status, on the development of pressure sores, and on the prolongation of life. Nutrition by the enteral route has no advantage over the routine oral route of feeding. In addition, the CRP can also be considered as an important prognostic marker for the initiation of tube feeding.

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REFERENCES

1. Silver AJ, Morley JE, Strome LS, et al. Nutritional status in academic nursing homes. J Am Geriatr Soc 1988;35:487–491.
2. Abbasi AA, Rudman D. Undernutrition in the nursing home: Prevalence, consequence, causes and prevention. Nutr Rev 1994;52:113–122.
3. Allard JP, Aghdassi E, McArthur M, et al. Nutrition risk factors for survival in the elderly living in Canadian long-term care facilities. J Am Geriatr Soc 2004;52:59–65.
4. Callahan CM, Finucane TE. Dysphagia and tube feeding. In: Cobbs EL, Duthie EH, Murphy JB, editors. Geriatrics Review Syllabus: A Core Curriculum in Geriatric Medicine. 4th ed. New York: American Geriatrics Society; 2000. p. 1999–2001.
5. Edington J, Kon P, Martyn CN. Prevalence of malnutrition in the community. Nutr 1997;13:238–240.
6. Mowé M, Bøhmer T. The prevalence of undiagnosed protein-calorie undernutrition in a population of hospitalized elderly patients. J Am Geriatr Soc 1991;39:1089–1092.
7. McWhirter JP, Pennington CR. Incidence and recognition of malnutrition in hospital. BMJ 1994;308:945–948.
8. Benrstein L, Shaw-Stiffel T, Schorow M, Brouillette R. Financial implication of malnutrition. Clin Lab Med 1993;13:491–507.
9. Ferguson R, O'Connor P, Crabtee B, et al. Serum albumin and prealbumin as predictors of clinical outcomes of hospitalized elderly nursing home residents. J Am Geriatr Soc 1993;41:545–549.
10. Mitchell SL, Kiely DK, Lipsitz LA. The risk factors and impact on survival of feeding tube placement in nursing home residents with severe cognitive impairment. Arch Intern Med 1997;157:327–332.
11. American Gastroenterological Association. Medical Position Statement: Guidelines for the use of enteral nutrition. Gastroenterology 1995;108: 1280–1301.
12. Folstein MF, Folstein S, McHugh PR. Mini-mental state: a practical method for grading the cognitive state of patients for the clinician. J Psychiatr Res 1975;12:189–198.
13. Katz S, Ford AB, Moskowitz RW, et al. Studies of illness in the aged. The index of ADL: A standardized measure of biological and psychological function. JAMA 1963;185:94–101.
14. Norton D. Calculating the risk: Reflection on the Norton scale. Decubitus 1989;2:24–31.
15. Ewald G, McKenzie C. Manual of Medical Therapeutics. 28th edition. Boston, MA: Little, Brown and Company, 1995. p. 49–50.
16. Barrett-Connor E, Edelstein SL, Corey-Bloom J, Wiederholt WC. Weight loss precedes dementia in community-dwelling older adults. J Am Geriatr Soc 1996;44:1147–1152.
17. Carver AD, Dobson AM. Effects of dietary supplementation of elderly demented hospital residents. J Hum Nutr Diet 1995;8:389–394.
18. Callahan CM, Haag KM, Weinberger M, et al. Outcomes of percutaneous endoscopic gastrostomy among older adults in a community setting. J Am Geriatr Soc 2000;48:1048–1054.
19. Ahronheim JC, Mulvihill M, Sieger C, et al. State practice variation in the use of tube feeding for nursing home residents with severe cognitive impairment. J Am Geriatr Soc 2001;49:148–152.
20. Peck A, Cohen CE, Mulvihill MN. Long-term enteral feeding of aged demented nursing home patients. J Am Geriatr Soc 1990;38:1195–1198.
21. Golden A, Beber C, Weber R, et al. Long-term survival of elderly nursing home residents after percutaneous endoscopic gastrostomy for nutritional support. Nurs Home Med 1997;5:382–389.
22. Meier DE, Ahronheim JC, Morris J, et al. High short-term mortality in hospitalized patients with advanced dementia: Lack of benefit of tube feeding. Arch Intern Med 2001;161:594–599.

23. Nair S, Hertan H, Pitchumoni CS. Hypoalbuminemia is a poor predictor of survival after percutaneous endoscopic gastrostomy in elderly patients with dementia. Am J Gastroenterol 2000;95:133–136.
24. Murphy LM, Lipman TO. Percutaneous endoscopic gastrostomy does not prolong survival in patients with dementia. Arch Intern Med 2003;163: 1351–1353.
25. Weaver JO, Odell P, Nelson C. Evaluation of the benefits of gastric tube feeding in an elderly population. Arch Fam Med 1993;2:953–956.
26. Yeh SS, Schuster MW. Geriatric cachecxia: A role of cytokines. Am J Clin Nutr 1999;70:183–197.
27. Ferrucci L, Harris TB, Guralnik JM, et al. Serum IL-6 level and the development of disability in older persons. J Am Geriatr Soc 1999;47: 639–646.
28. Leng S, Chaves P, Koenig K, Walston J. Serum interleukin-6 and hemoglobin as physiological correlation in the geriatric syndrome of frailty. A pilot study. J Am Geratr Soc 2002;50:1268–1271.
29. Braun UK, Rabeneck L, McCullough LB, et al. Decreasing use of percutaneous endoscopic gastrostomy tube feeding for veterans with dementia-racial differences remains. J Am Geriatr Soc 2005;53: 242–248.
30. Clarfield MA, Monette J, Bergman H, et al. Enteral feeding in end-stage dementia: A comparison of religious, ethnic and national differences in Canada and Israel. J Gerontol A Biol Sci Med Sci 2006;61:621–627.
31. Mitchell SC, Teno JM, Roz J, et al. Clinical and organizational factors associated with feeding tube use among nursing home residents with advanced cognitive impairment. JAMA 2003;290:73–81.