ORIGINAL INVESTIGATION

Feeding Tubes and the Prevention or Healing of Pressure Ulcers

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Background: The evidence regarding the use of feeding tubes in persons with advanced dementia to prevent or heal pressure ulcers is conflicting. Using national data, we set out to determine whether percutaneous endoscopic gastrostomy (PEG) tubes prevent or help heal pressure ulcers in nursing home (NH) residents with advanced cognitive impairment (ACI).

Methods: A propensity-matched cohort study of NH residents with ACI and recent need for assistance in eating was conducted by matching each NH resident who had a feeding tube inserted during a hospitalization to 3 without a PEG tube inserted. Using the Minimum Data Set (MDS), we examined 2 outcomes: first, whether residents without a pressure ulcer developed a stage 2 or higher pressure ulcer (n=1124 with PEG insertion); and second, whether NH residents with a pressure ulcer (n=461) experienced improvement of the pressure ulcer by their first posthospitalization MDS assessment (mean [SD] time between evaluations, 24.6 [32.7] days).

Results: Matched residents with and without a PEG insertion showed comparable sociodemographic characteristic, rates of feeding tube risk factors, and mortality. Adjusted for risk factors, hospitalized NH residents receiving a PEG tube were 2.27 times more likely to develop a new pressure ulcer (95% CI, 1.95-2.65). Conversely, those with a pressure ulcer were less likely to have the ulcer heal when they had a PEG tube inserted (OR 0.70 [95% CI, 0.55-0.89]).

Conclusions: Feeding tubes are not associated with prevention or improved healing of a pressure ulcer. Rather, our findings suggest that the use of PEG tube is associated with increased risk of pressure ulcers among NH residents with ACI.

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Dementia is the sixth leading cause of death in the United States among persons 65 years or older. More than 5 million persons are afflicted with dementia, and the number is expected to increase to 16 million by 2050. Persons dying from dementia face a disease trajectory of progressive cognitive and functional impairment, with 86% developing eating problems that often lead to malnutrition, recurrent infections with a burdensome pattern of hospitalizations, and death.[1] Multiple systematic reviews of the literature report that in persons with advanced dementia, tube feeding does not improve survival or prevent aspiration pneumonia.[2-4] A 2009 Cochrane review reported that the evidence was inconclusive regarding whether feeding tubes improved or prevented pressure ulcers.[4]

Based on examination of administrative data, two studies found that feeding tubes were not associated with the development and healing of pressure ulcers, although the actual effect sizes were not published.[5,6] In addition, 3 small studies examined the role of feeding tubes in preventing or healing of pressure ulcers. One study was limited by number of controls and reported, for a sample size of only 58 patients who underwent a percutaneous endoscopic gastrostomy (PEG) tube placement for any indication, that 58.8% of the ulcers healed, and 75% of patients did not develop a pressure ulcer.[7] The 2 other studies examined patients with and without dementia and included fewer than 100 patients.[8,9]

Previous research has framed the outcomes to the insertion and use of PEG feeding tubes for patients with advanced dementia in terms of whether the tubes benefit the patients (eg, prevent or help heal a pressure ulcer). However, there is realistic concern that the insertion and use of feeding tubes may cause harm compared with careful hand feeding. Many nursing home (NH) residents with a feeding tube may be physically or pharmaco-

See Invited Commentary at end of article

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logically restrained to prevent them from pulling out the tube.[10] Physical or pharmacological restraints can result in immobility that can increase risk of a pressure ulcer. In addition, many tube-fed patients can develop diarrhea from tube feeding that potentially can increase the risk of pressure ulcer.[11,12] Thus, a feeding tube might offer no benefit and in fact be associated with increased risks for pressure ulcers in patients with advanced dementia.

Using 8 years of national Minimum Data Set data and Medicare claim files, we set out to characterize the benefits and risks of PEG feeding tube insertion with regard to the potential indication of prevention or healing of a pressure ulcer in NH residents with advanced cognitive impairment. In contrast to previous studies, we used a propensity-matched cohort design that addressed the issue of selection bias, and our large national sample provided sufficient power.

METHODS

SAMPLE

The sample was obtained from a national repository of the Minimum Data Set (MDS) that was merged with Medicare Part A and 20% of Medicare Part B claims from 1999 through 2007. The MDS is a federally mandated, quarterly assessment containing detailed demographic and clinical information on every resident living in all Medicare- or Medicaid-certified US nursing facilities. Since most NH residents have a PEG feeding tube inserted during an acute-care hospitalization,[13] we restricted the analysis to NH residents who had been hospitalized at least once within the first year of entering the cohort. We included only NH residents with advanced cognitive impairment with a first conversion of their MDS Cognitive Performance Scale (CPS) to a score of 6, indicating severe impairment and need for assistance in eating.[14] The date of this first CPS score of 6 is our baseline date. We excluded those who died within 2 weeks of the baseline MDS assessment or who had any evidence of PEG feeding tubes in the prior 6 months, according to Medicare claims. Hospitalizations with any *International Classification of Diseases, Ninth Revision* (*ICD-9*) diagnosis indicating a pressure ulcer were excluded from the analysis that examined PEG feeding tube and new pressure ulcers.

STUDY VARIABLES

Using the MDS, we examined 2 outcomes: first, whether residents without a pressure ulcer developed a stage 2 or higher pressure ulcer; and second, whether NH residents with a pressure ulcer experienced improvement in the pressure ulcer. The number and stage of pressure ulcers is recorded by a registered nurse at both the annual and quarterly MDS assessments. Our main independent measure was whether the patient had a PEG feeding tube inserted during a hospitalization. We defined PEG tube insertions using *ICD-9* procedure codes 43.1, 43.11, 43.19, and 44.32, as well as CPT-4 (*Current Procedural Terminology, Fourth Edition*) codes 43246, 43653, 43750, 43830, 43832, 44372, 44373, and 74350, as identified in previous research,[15] and were tracked for 1 year after baseline.

STATISTICAL ANALYSIS

Propensity-score matching was used to address issues of selection bias due to differences in risk factors between those who received a PEG tube and those who did not that might have differentially affected our outcomes if left unaccounted for. The propensity model predicted whether a PEG feeding tube was inserted up to 1 year after the baseline MDS date. A propensity-score match was calculated separately for the cohorts of our 2 outcomes. For each outcome, each hospitalized NH resident with a feeding tube inserted was matched to the 3 hospitalized NH residents without a feeding tube based on the nearest propensity scores. Weights of 1/3 were used to adjust the sample size to the number of NH residents with a PEG feeding tube inserted. Matching was performed with replacement; hence, the same NH resident without a PEG tube might have been near (and matched to) more than 1 of the NH residents with a PEG Tube. To confirm the validity of the match, we determined whether NH residents with and without PEG feeding tube insertions had similar covariates included in the propensity-score model, such as socio-demographic characteristics and risk factors for feeding tubes, and similar outcomes such as survival.

The propensity scores were calculated with a logistic regression model. The choice of which covariates to include in these models was based on findings in our research group's previous work[10,13,16] that characterized which residents had a feeding tubes inserted during hospitalizations 1 year after baseline. Variables included in the model were (1) sociodemographic variables (age, sex, race, marital status, education); (2) evidence of advance-care planning including advance directives, do-not-resuscitate order, do-not-hospitalize order, and any feeding restrictions; (3) 19 medical diagnoses (eg, cancer, *clostridium difficile* diarrhea, stroke, hip fracture, diabetes); (4) clinical conditions including dehydration, inability to consume food or fluids, fever, wound infection, weight loss, swallowing problems, chewing problems, syringe feeding, mechanically altered diet, and dietary supplementation (5) body mass index (BMI); (6) measures of functional status and disease severity, including activities of daily living score; and (7) 2 models that predict mortality (the ADEPT [advanced dementia prognostic tool] score[17] and CHESS [changes in health, end-stage disease, and symptoms and signs] score[18]). All of these variables were based on data from the baseline MDS evaluation completed prior to the hospitalization. Time between baseline MDS evaluation and hospitalization was included in the propensity score to obtain matches with similar timing of hospitalization relative to baseline.

The odds of presence of feeding tube preventing or healing pressure ulcers were calculated with a fixed-effect (conditional) logistic model that accounted for correlation of PEG tube and non–PEG tube matches within the same matched set and sampling with replacement. All statistical analyses were performed using STATA, version 11 (StataCorp LP).

For each outcome, we conducted sensitivity analyses to examine the robustness of our findings. For the first outcome, we defined a pressure ulcer as the development of stage 2 or higher pressure ulcer. The analysis was then repeated to examine the risk of development of stage 4 pressure ulcer. For the second outcome examining whether there was an improvement in the stage of the pressure ulcers, we examined whether the results differed by the initial stage of the pressure ulcer. Because the MDS evaluation could have been done at different times prior to the hospitalization, we conducted an additional analysis that examined only those MDS evaluations done within 30 days prior to the relevant hospitalization. Finally, we examined whether the observed associations held if inception of the cohort required developing a CPS score of 6 plus having 1 of the following potential risk factors for a feeding tube: (1) weight loss; (2) aspiration pneumonia; (3) concern for inadequate fluid intake; and/or (4) concern for ability to swallow.

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Table. Baseline Characteristics of Hospitalized Nursing Home Residents With and Without a Feeding Tube Inserted During the Relevant Hospitalization[a]

	No Pressure Ulcer			Pressure Ulcer		
Characteristic	Without Feeding Tube	With Feeding Tube	*P* Value	Without Feeding Tube	With Feeding Tube	*P* Value
Weighted persons	n = 1124	n = 1124	NA	n = 461	n = 461	NA
Unique persons	n = 2082	n = 1124	NA	n = 754	n = 461	NA
Age, mean (SD), y	82.7 (7.5)	82.9 (7.1)	.40	82.5 (7.6)	83.0 (7.5)	.19
Married	27.5	24.8	.04	28.6	27.8	.70
Female	68.7	70.8	.13	64.6	65.3	.75
Race						
White	85.4	83.3	.15	58.2	56.8	.55
African American	25.5	27.0	.29	32.2	32.1	.96
Hispanic	7.4	7.6	.88	7.7	9.1	.30
Other	1.6	2.5	.22	1.8	2.0	.82
Completed high school	54.9	53.1	.24	47.9	51.4	.14
Advance care planning						
DPOA	23.4	22.8	.64	14.6	17.8	.07
Living will	9.2	9.6	.65	5.6	17.8	.67
DNR order	35.3	33.7	.28	33.8	33.8	.97
DNH order	1.3	0.9	.25	1.0	1.1	.88
Orders to forgo artificial hydration and nutrition	8.36	8.70	.62	2.7	2.6	.89
Medical history						
Diabetes	23.2	23.3	.92	38.9	34.9	.08
CAD	12.8	11.7	.23	11.6	11.2	.85
CHF	15.5	14.7	.43	22.4	18.9	.07
COPD	10.7	10.7	.99	11.9	9.5	.11
Cancer	4.3	3.5	.13	4.5	4.6	.91
Hip fracture	6.5	6.5	.98	9.8	10.6	.58
Risk factors for feeding tube insertion						
Weight loss	22.3	23.7	.27	31.0	30.1	.72
Swallowing problems	35.8	38.9	.04	41.5	43.2	.47
Chewing problems	51.0	52.0	.53	54.6	56.8	.33
Mechanically altered diet	42.5	44.8	.13	51.5	53.4	.43
ADL score, mean (SD)	25.8 (2.9)	26.2 (2.5)	<.001	27.2 (1.5)	27.2 (1.5)	.43
Mortality, d						
30	1.9	2.0	.92	3.3	3.0	.76
60	5.5	7.0	.04	12.7	10.6	.17
180	20.1	24.0	.004	37.8	40.6	.23

Abbreviations: ADL, activities of daily living; CAD, coronary artery disease; CHF, congestive heart failure; COPD, chronic obstructive pulmonary disease; DNH, do not hospitalize; DNR, do not resuscitate; DPOA, durable power of attorney; NA, not applicable.

[a]Unless otherwise indicated, data are reported as percentage of patients.

RESULTS

SAMPLE DESCRIPTION

A total of 18 021 NH residents with ACI experienced 1 to 5 hospitalizations in the year after conversion to a CPS score of 6. Of these persons, 1124 had a PEG feeding tube inserted without evidence of a pressure ulcer (6.2%) and they survived until a follow-up MDS evaluation that was completed a mean (SD) of 23.3 (30.0) days after the relevant hospitalization. The nearest-neighbor propensity match yielded 2082 unique NH residents without a PEG feeding tube placement. The **Table** summarizes the baseline characteristics of NH residents with a feeding tube inserted and their matched NH residents without a feeding tube inserted. As seen in the Table, 25.5% of the NH residents without a PEG tube were black, compared with 27.0% of NH residents with a PEG tube inserted ($P = .29$). Nursing home residents with and without PEG tubes inserted did not differ in medical conditions or risk factors for feeding tube insertion noted in the baseline MDS. Thirty-day mortality rate was similar between groups (1.9 vs 2.0; $P = .92$), although those with a feeding tube inserted experienced a slightly higher 180-day mortality rate (20.1 vs 24.0; $P = .01$). These results suggest a successful propensity-score match.

Among NH residents with a pressure ulcer at baseline, 461 had a stage 2 or higher pressure ulcer (2.6%) and had a PEG tube inserted. A total of 754 unique non-PEG tube NH residents were selected with replacement as matches. As summarized in the Table, NH residents with a preexisting pressure ulcer and PEG feeding tube and their propensity-matched NH residents with a pressure ulcer but without a PEG feeding tube were similar in sociodemographic characteristics, medical conditions, advance care planning, risk factors for feeding tube insertion, and survival.

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POTENTIAL RISKS AND BENEFITS OF PEG FEEDING TUBE INSERTION

The risks of developing a new stage 2 or higher pressure ulcer was examined among the 1124 NH residents with a PEG tube, with data from 2082 NH residents without a PEG tube weighted to achieve an equal number of NH residents with and without a PEG feeding tube inserted during a hospitalization. At the follow-up MDS evaluation, 35.6% of those with a PEG tube had pressure a ulcer compared with 19.8% of the NH residents without a PEG tube. The adjusted odds ratio (OR) of developing a new stage 2 or higher pressure ulcer was 2.27 (95% CI, 1.95-2.65). As a sensitivity analysis, we conducted a similar analysis examining the risk of PEG feeding tube insertion for development of new stage 4 ulcer and found an adjusted OR of 3.21 (95% CI, 2.14-4.89). A second sensitivity analysis examined an NH resident with a CPS score of 6 plus 1 or more of the following risk factors: (1) weight loss; (2) aspiration pneumonia; (3) concern for inadequate fluid intake; and/or (4) concern for ability to swallow. Seventy-four percent had 1 or more of these risk factors. In this subgroup, the OR for developing a pressure ulcer while intubated with a PEG tube was 2.60 (95% CI, 2.14-3.17).

The potential benefits of the PEG tube were examined among hospitalized NH residents with preexisting stage 2 or higher pressure ulcers. Improvement was defined as a decrease in the stage of the pressure ulcer noted on the follow-up MDS evaluation. At follow-up, 27.1% of the ulcers of NH residents with PEG tubes improved compared with 34.6% of the NH residents without a PEG tube inserted during hospitalization. The adjusted OR for a pressure ulcer improving while a PEG tube was in place was 0.70 (95% CI, 0.55-0.89). As a sensitivity analysis, we repeated this analysis stratified by the stage of the pressure ulcer and found the similar result that PEG tube insertion was not associated with improved rate of healing: among 262 PEG tube NH residents with stage 2 pressure ulcers, the adjusted OR was 0.66 (95% CI, 0.45-0.97); among 57 PEG tube NH residents with stage 3 pressure ulcers, the adjusted OR was 0.57 (95% CI, 0.26-1.25); and among 142 PEG tube NH residents with stage 4 pressure ulcers, the adjusted OR was 1.0 (95% CI, 0.55-1.86). Because the MDS is completed at different times prior to the hospitalization, we examined only those 373 PEG tube NH residents (and their matches) who had MDS data completed within 30 days of the relevant hospitalization and found an adjusted OR of 0.76 (95% CI, 0.42-1.37), indicating that the insertion of a PEG feeding tube was not associated with improved healing of pressure ulcers. Similar to the sensitivity analysis of the risk of developing a pressure ulcer, the potential of a PEG feeding tube healing a pressure ulcer was examined among those 92% of NH residents with 1 or more of the 4 risk factors for a feeding tube and found an adjusted OR of 0.78 (95% CI, 0.60-1.02).

COMMENT

While the risk of operative mortality of PEG tube insertion is small, our results suggest that feeding tubes are not beneficial, and instead they may be associated with increased risk of developing a pressure ulcer. Previous research on the outcomes of PEG feeding tubes and the prevention or healing of pressure ulcer was inconclusive.[4] Nonetheless, 74.6% of physicians list their belief that feeding tubes improve pressure ulcer healing as a reason for inserting them.[19] Contrary to this perception, our results, using a propensity-score matched cohort study, indicate that PEG feeding tube insertion doubles the risk of new pressure ulcer and furthermore that PEG feeding tubes do not promote the healing of existing pressure ulcers. A recent 5-state survey of bereaved family members found that more than one-third of physicians did not discuss the risks of feeding tube insertion.[10] The present study provides evidence that there are important risks of PEG feeding tube insertion that ought to be discussed.

Given the evidence that high-protein oral nutritional supplements can prevent pressure ulcers,[20] our results may seem counterintuitive. Although our research cannot identify the exact mechanism by which feeding tubes are associated with a higher rate of pressure ulcers, there are plausible mechanisms that link the insertion of a PEG tube to development of pressure ulcers. Physical and pharmacological restraints may result in immobility, a risk factor for the development of pressure ulcer. Furthermore, the osmolality of the tube feedings may induce diarrhea, which is another risk factor for the development of pressure ulcer.

There are certain limitations that should be acknowledged in interpreting these results. We relied on the MDS and diagnoses reported on Medicare hospital claims to examine whether the NH resident had a stage 2 or higher pressure ulcer. In the analysis of the development of pressure ulcers, hospital claims were used to ensure that the patient did not have a pressure ulcer during the hospitalization in which a PEG tube was inserted. During the time period of this study, hospitals received increased reimbursement if the patient had a pressure ulcer.[21] One study focusing on the documentation of pressure ulcers in Medicare claims data found they were overdocumented.[22] Despite this result, to address the concern that hospitals may not document lower stages of pressure ulcers, a sensitivity analysis examined the risk of developing a stage 4 ulcer and found an increased risk of new pressure ulcers with PEG tube insertion. While the Centers for Medicare & Medicaid Services use the MDS to document healing of pressure ulcers, the National Pressure Ulcer Advisory Panel recommends use of the Pressure Ulcer Scale for Healing (PUSH) over reverse staging of pressure ulcers.[23]

The MDS data used in our study were entered at different times from the hospitalization in which a PEG feeding tube was inserted. As a sensitivity analysis, we examined those NH residents with and without a PEG feeding tube insertion who had their MDS data completed within 1 month of the relevant hospitalization and found similar results.

Finally, it is possible that unobserved factors associated with the feeding tube insertion may have resulted in the development of the pressure ulcer or the nonhealing of the pressure ulcer. Our study used a propensity-score nearest-neighbor matched cohort design. The potential drawback to this approach is that the matching can only adjust for those items included in the MDS and Medicare Claims files. The MDS provides a wealth of sociodemographic data and risk factors for feeding tube in-

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sertion, and the Table lists evidence of the adequacy of the match, but there is a chance that some important unobserved confounder was omitted. On the other hand, it would be difficult to randomize patients with advance cognitive impairment to receive a PEG feeding tube. Thus, our propensity-matched cohort study provides important information to guide decision making.

In conclusion, previous syntheses of the literature have concluded that feeding tubes do not benefit patients with advanced dementia.[3,4,24] Our findings regarding the risk of developing new stage 2 or higher pressure ulcers suggest that PEG feeding tubes are not beneficial, but in fact they may potentially harm patients.

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INVITED COMMENTARY

Tube Feeding and Pressure Ulcers

Evidence of Harm From the Intervention

"Malnutrition" is frequently cited when patients with pressure sores do poorly, and "adequate" nutrient intake (or input) is part of most guidelines on pressure sore management. This may be misleading, however. Although not conclusive, available evidence consistently suggests that nutrition support—parenterally, with oral supplements, or via enteral tube feeding—does not improve pressure sore outcomes.

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