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Comparative outcomes for pelvic organ prolapse surgery among nursing home residents and matched community-dwelling older adults

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Abstract

Purpose: To compare short- and long-term outcomes between nursing home residents and matched community-dwelling older adults undergoing surgery for pelvic organ prolapse (POP).

Materials and Methods: This retrospective cohort study evaluates women ≥65 years of age undergoing different types of POP repairs (anterior/posterior, apical, and colpocleisis) between 2007 and 2012 using Medicare claims and the Minimum Data Set for Nursing Home Residents. Long-stay nursing home residents were identified and propensity score matched (1:2) to community dwelling older individuals based on procedure type, age, race, and Charlson Score. Generalized Estimating Equation models were created to determine the relative risk (RR) of hospital length of stay ≥3 days, 30-day complications, and 1-year mortality between the two groups. Kaplan Meier curves were created comparing 1-year mortality between groups.

Results: There were 799 nursing home residents and 1598 matched community-dwelling older adults who underwent POP surgery and were included in our analyses. Nursing home residents demonstrated statistically significant increased risk for hospital length of stay ≥3 [38.9% vs 18.6%; adjusted RR 2.1 (95% CI 1.8–2.4)], 30-day complications [15.1% vs 3.8%; aRR 3.9 (95% CI 2.9–5.3)], and 1-year mortality [11.1% vs 3.2%; aRR 3.5 (95% CI 2.5–4.8)] compared to community-dwelling older adults. Kaplan Meier curves illustrated similar survival findings at 1-year [11.1% (95% CI 9.0%–13.3%) vs 3.2% (95% CI 2.3%–4.1%), $p < 0.0001$].

Conclusions: Despite matching on several characteristics, nursing home residents demonstrated worse short- and long-term outcomes compared to community-dwelling older adults, suggesting other key vulnerabilities exist that add additional surgical risk in this population.

Keywords

Elderly; geriatric; colpocleisis; frailty; mortality

Introduction

Pelvic organ prolapse (POP) is an extremely common condition among older women, affecting nearly half of women over the age of 50.¹ With the older population growing at a rapid rate, it is predicted that the incidence of POP will increase nearly 50% from 2010 to 2050.^{2,3} Many women with POP ultimately seek surgery for this condition, resulting in a 12.6% cumulative risk of having POP surgery by the age of 80.⁴ However, surgery in older adults may not be as straightforward as it is in younger counterparts due to the presence of several aging-related considerations, making them particularly vulnerable for poor surgical outcomes.

The nursing home population represents a large population of the most vulnerable older adults. It is estimated that approximately 35–45% of individuals in the United States over the age of 65 will enter a nursing home at some point during their life.^{5,6} This population is particularly vulnerable to poor surgical outcomes due to the medical and social factors that led them to institutionalization in the first place. However, surgical outcomes in nursing home residents for commonly performed procedures, such as for POP, have not been studied and are poorly understood, making surgical decision-making in this unique and vulnerable population challenging.

In order to address this critical knowledge gap, we designed a retrospective cohort study using data from the Minimum Data Set (MDS) for Nursing Home residents and the Medicare Inpatient files to evaluate and compare short- and long-term outcomes between dependent nursing home residents and propensity-matched community-dwelling older adults undergoing surgery for POP from 2007–2012. By matching based on tangible factors such as age, race and comorbidity, we expect to see worse outcome among nursing home residents likely attributable to their underlying vulnerability and dependency.

Methods

Subjects and Databases

We identified a cohort of Medicare beneficiaries undergoing surgery for POP from 2007 to 2012 using the Medicare Inpatient Files. These files contain data on all fee-for-service inpatient hospitalizations for Medicare beneficiaries ages 65 and older. Individuals were identified using *International Classification of Diseases, Ninth Revision* (ICD-9) procedure codes according to the following categories: anterior and posterior POP repairs (ICD-9 codes 70.50, 70.51, 70.52, 70.53, 70.54, and 70.55), apical POP repairs (ICD-9 codes 70.77 and 70.88), and colpocleisis procedures (ICD-9 code 70.8). The following procedure codes were used to identify concurrent hysterectomy at the time of prolapse repair (ICD-9 codes 68.0, 68.41, 68.49, 68.61, 68.71, 68.9). We created the following procedure categories for our analyses: anterior/posterior repair, apical repair with and without hysterectomy, apical repair with anterior/posterior repair, and colpocleisis. Of note, there was only one nursing home resident who underwent an anterior/posterior repair with apical repair and hysterectomy, so we did not include this category of procedures in our analyses.

We were then able to determine which individuals who underwent POP procedures were long stay nursing home residents using the MDS 3.0 for nursing home residents. The MDS is a quarterly mandatory assessment for all nursing home residents in the United States who receive Medicare or Medicaid benefits, and can be linked to the Medicare Inpatient Files. For the purposes of this study, nursing home residents were considered to be long term residents if they had completed at least 2 or more consecutive assessments more than 90 days apart during the 12 months prior to their POP procedure.

Outcome Measures

The primary outcomes of this study included both short- and long-term outcomes associated with POP repairs. Short-term outcomes included hospital length of stay (LOS) and 30-day complications. Thirty-day complications were identified using ICD-9 diagnosis codes from the Medicare Inpatient Files, which are based on the existing literature^{7,8} and listed in the Supplemental Table. One-year mortality was evaluated as a long-term outcome and measured using the date of death from the Medicare Denominator File.

Covariates

Demographic data including age and race were obtained from the Medicare Inpatient Files. Information on comorbidities were abstracted from the Medicare Inpatient Files and the MDS and were used to calculate the Charlson Comorbidity Index score, in a manner consistent with the literature.⁹

Statistical Analysis

To control for potential unmeasurable confounders associated with poor outcomes, we performed propensity score matching between nursing home residents and community-dwelling Medicare beneficiaries. Propensity scores were computed as the predicted probabilities from a logistic regression model predicting nursing home vs. community-dwelling individuals. In this study, we matched based on the following covariates: procedure type, age, race, and Charlson Comorbidity Index score. Community-dwelling and nursing home residents were then propensity matched using caliper matching without replacement (caliper width of 0.2 standard deviations of the logit propensity) to derive a matched sample.¹⁰ To ensure effectiveness of the propensity score balancing, we compared standardized differences in each predictor before and after matching. Once an acceptable degree of matching was achieved, we then assessed the association of outcomes (hospital length of stay 3 days, 30-day complications, and 1-year mortality) with the primary predictor of nursing home vs. community-dwelling status in the matched sample via three separate Generalized Estimating Equation (GEE) models – one for each outcome of interest. To look more closely at hospital length of stay, we performed an additional regression analysis using Least Square Means from a linear model. In order to illustrate differences in 1-year survival trends between community-dwelling older adults and nursing home residents, we created Kaplan Meier survival curves to test for differences between the two groups with a p value derived from a log-rank test.

For all analyses, $P=0.05$ on a two-sided significance test with a 5% α level was considered to be statistically significant. Analyses were performed using SAS Institute statistical software, v.9.4.

Results

The characteristics of our unmatched and propensity matched cohorts are shown in Table 1. In the unmatched data, there were a total of 214,722 individuals who underwent surgery for POP during the study period, 802 of which were nursing home residents. In the propensity matched data, there were a total of 2,412 older adults, 1608 of whom were community-dwelling and 804 of whom resided in a nursing home. Among the matched cohort, 52.1% had anterior/posterior repairs, 19.4% had a colpocleisis, 16.3% had anterior/posterior repairs with an apical repair, 9.4% had apical repairs, and 2.6% had apical repairs with hysterectomy. The mean age of the matched study cohort was 78.8 ± 6.6 years, 88.7% were white, and 9.0% had a Charlson Score ≥ 3 .

Differences in short-term outcomes following POP surgery between community-dwelling older adults and nursing home residents are shown in Table 2. Nursing home residents had longer mean hospital length of stay (3.3 ± 4.7 vs. 2.1 ± 2.7 days, $p<0.0001$), higher rates of any surgical complication (15.1% vs. 3.8%, $p<0.0001$), higher rates of ≥ 3 complications (4.0% vs. 0.8%, $p<0.0001$), and higher rates of individual complications including postoperative hemorrhage, cardiovascular complications, delirium, infection, acute renal failure, pulmonary complications, and deep venous thrombosis/pulmonary embolism (all p 's <0.05). Nursing home residents and community-dwelling older adults had similar rates of the following complications: complications secondary to anesthesia, wound complications, nervous system complications including shock, and deep venous thrombosis and pulmonary embolism.

Table 3 shows the relative risk (RR) of short- and long-term outcomes for nursing home residents compared to community-dwelling older adults. Nursing home residents had increased relative risk of hospital length of stay ≥ 3 days [adjusted RR (aRR) 2.1 (95% CI 1.8–2.4; $p<0.0001$)], increased risk of 30-day complications [aRR of 3.9 (95% CI 2.9–5.3; $p<0.0001$)], and increased risk of 1-year mortality [aRR 3.5 (95% CI 2.5–4.8; $p<0.0001$)]. Of note, there were no significant predictors of 30-day complications or 1-year mortality, other than living in a nursing home. Significant predictors of hospital length of stay ≥ 3 days included age ≥ 85 years v. 65–69 years [aRR 1.3 (95% CI 1.0–1.7)], Charlson Comorbidity Score of 2 v. 0–1 [aRR 1.3 (95% CI 1.1–1.5)], Charlson Comorbidity Score ≥ 3 v. 0–1 [aRR 2.6 (95% CI 1.7–3.9)], anterior/posterior repair with apical repair v. anterior/posterior repair [aRR 1.22 (95% CI 1.0–1.5)], apical repair with hysterectomy v. anterior/posterior repair [aRR 2.7 (95% CI 2.1–3.5)], apical repair without hysterectomy v. anterior/posterior repair [aRR 2.0 (95% CI 1.6–2.3)], and calendar years 2010 and 2011 v. 2007 [aRR 0.6 (95% CI 0.5–0.8) and aRR 0.65 (95% CI 0.5–0.8), respectively]. In order to provide more information on hospital length of stay, an additional analysis using Least Squares Means from a Linear model and determined that nursing home residents spent a mean of 3.3 (2.7–3.9) days in the hospital compared to a mean of 2.3 (1.9–2.8) days for community-dwelling older adults.

Kaplan Meier Curves depicting differences in 1-year mortality between community-dwelling older adults and nursing home residents are shown in Figure 1. As noted in the figure, nursing home residents had an increased 1-year mortality rate of 11.1% (95% CI 9.0%–13.3%) compared to 3.2% (95% CI 2.3%–4.1%) among community-dwelling older adults, $p<0.0001$.

Discussion

Nursing home residents demonstrated increased relative risk of hospital length of stay 3 days, 30-day complications, and 1-year mortality compared to community-dwelling older adults, despite matching on several key factors such as type of POP procedure, age, race, and Charlson Score. Additionally, one-year mortality was found to be four-fold higher among nursing home residents compared to matched community-dwelling older adults (11.1% vs. 3.2%, respectively, $p<0.0001$), suggesting that factors other than age and comorbidity are influencing surgical outcomes.

Of note, nursing home residents represent one of the most dependent and vulnerable populations, who are often defined by needing assistance with activities of daily living and who embody many medical and social vulnerabilities such as cognitive and functional impairment, being unmarried, the absence of a caregiver, and frailty.¹¹ We have previously compared outcomes between nursing home residents and community-dwelling older Medicare beneficiaries undergoing surgery for bleeding duodenal ulcers, cholecystectomy, appendectomy, and colectomy. This study found that nursing home residents demonstrated substantially higher rates of 30-day operative mortality (42% versus 26% for bleeding duodenal ulcer; 32% versus 13% for colectomy; 12% versus 2% for appendectomy; 11% versus 3% for cholecystectomy).¹²

Other studies specifically evaluating procedures such as transurethral resection of the prostate (TURP), breast cancer surgery, cystoscopy, bladder biopsy, transurethral resection of bladder tumor, removal of ureteral obstruction, and suprapubic tube placement, demonstrated high 1-year mortality ranging from 29% to 50%, depending on the procedure studied, in addition to adverse functional outcomes among nursing home residents.^{13–15} Our 1-year mortality rate of 11.1% among nursing home residents undergoing surgery for POP, while high compared to the general population, is favorable compared to those associated with these other procedures, suggesting that our population may represent a more robust subset of institutionalized individuals. However, these rates should give us pause to consider potential alternatives to surgery (such as pessary use) among similar patients, particularly among those who are institutionalized and dependent.

As previously mentioned, one defining characteristic of nursing home residents is the presence of frailty.¹¹ Data specifically addressing outcomes related to frailty among older women undergoing surgery for POP are largely lacking in the literature and are limited to 30-day complications among largely non-institutionalized adults. We previously reported on this topic using data from the American College of Surgeons National Surgical Quality Improvement Program (ACS NSQIP) wherein we identified 12,731 women undergoing both obliterative and reconstructive surgery for POP using the NSQIP Frailty Index (NSQIP-FI),

which is an 11-item validated measure of frailty designed specifically for use in these data. We reported that frailty was associated increased odds of 30-day complications [aOR 2.8 (95% CI 1.8–3.0)], while adjusting for age and other important clinical factors.¹⁶ A separate study, also using ACS NSQIP data, used a 5-point frailty index (the Modified Frailty Index-5 Score) and demonstrated similar findings among a cohort of 27,403 women, where frailty was associated with increased odds of 30-day complications [OR 2.5 (95% CI 1.3–4.6)] among their elderly (ages 69–75) population of women.¹⁷ These findings are consistent with one another, as they look at similar ACS NSQIP populations of all-comers, and are appropriately lower than our finding of an increased relative risk of 30-day complications among our older and more frail cohort [aRR 3.5 (95% CI 2.5–4.8)].

Beyond studies using the ACS NSQIP data, a literature review of POP complications among women ages 70 and older reported on 394 women undergoing various types of POP repairs and reported a complication rate of 4.6%.¹⁸ This complication rate is fairly similar to our reported rate of 3.8% among community-dwelling older adults and much lower than our complication rate of 15.1% among nursing home residents. Furthermore, our results among community-dwelling older adults are consistent with the existing literature, and our outcomes for nursing home residents are understandably worse.

Our study found that the mean length of stay was 3.3 versus 2.1 days in nursing home residents compared to community-dwelling older adults. Our regression analysis revealed that factors associated with longer hospital length of stay (≥ 3 days) included residing in a nursing home, older age, higher comorbidity, certain procedures (apical repairs with anterior/posterior repairs and/or hysterectomy, while certain calendar years were less likely to be associated with longer length of stay (2010 and 2011). While these findings are largely intuitive in nature, it is also important to consider that longer length of stay could be related to non-clinical factors such as regulatory issues requiring a minimum length of stay prior to discharge to a skilled nursing facility.

This study should be interpreted with certain limitations in mind. First, we are somewhat limited based on the type of data available to us via the Medicare Inpatient files and the MDS, and we lack key information pertaining to important patient-related factors influencing surgical decision-making such as stage of prolapse, prior pelvic surgical history, previous therapies tried, degree of bother related to prolapse, and cause of death. Additionally, as POP surgery is largely performed to improve quality of life, we lack important information on health-related quality of life (HRQOL) both before and after surgery. Future studies that are able to include important information on patient reported outcomes and HRQOL are needed in order to expand our knowledge of these procedures in the context of our findings. Another limitation of our study is that our data are potentially limited by selection bias, as we identified our cohort based on patients who had surgery for POP. Furthermore, we lack information on patients who had similar conditions and chose not to pursue surgical treatment. Furthermore, our study may represent a bias towards the individuals who are healthier and more able to withstand surgery. However, this would likely bias our findings towards more conservative estimates of poor outcomes and would reflexively serve to underestimate (not overestimate) our findings.

Conclusions

This study found that nursing home residents demonstrated markedly increased risk of hospital length of stay 3 days, 30-day complications, and 1-year mortality compared to age and comorbidity matched community-dwelling older adults. Furthermore, we believe that other medical and social factors present in nursing home residents, such as frailty, account for this difference and should be considered in the surgical decision-making process. Both older and frail older women should be carefully counseled about the real potential risks of POP surgery and alternatives should be considered where appropriate

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Figure 1.
Kaplan Meier curve comparing 1-year mortality between nursing home residents and matched community-dwelling older adults undergoing surgery for POP.

Table 1.

Cohort characteristics used for propensity score matching

Characteristics	Unmatched Data				Matched Data			
	All Subjects	Community-dwelling	Nursing Home	P value	All Subjects	Community-dwelling	Nursing Home	P value
Observed N (%) :	214,722 (100.0)	213,920 (99.63)	802 (0.37)		2397 (100.0)	1598 (66.7)	799 (33.3)	
Procedure Type N (%) :								
Anterior/Posterior Repair	122,507 (57.1)	122,091 (57.1)	416 (51.9)	<0.001	1255 (52.4)	839 (52.5)	416 (52.1)	0.9966
Apical Repair	22,600 (10.5)	22,523 (10.5)	77 (9.63)		223 (9.3)	146 (9.1)	77 (9.4)	
Apical Repair with Hysterectomy	4,072 (1.9)	4051 (1.9)	21 (2.6)		64 (2.7)	43 (2.7)	21 (2.6)	
Anterior/Posterior Repair with Apical Repair	58,580 (27.28)	58,450 (27.3)	130 (16.2)		390 (16.3)	260 (16.3)	130 (16.3)	
Colpocleisis	6,963 (3.2)	6805 (3.2)	158 (19.7)		465 (19.4)	310 (19.4)	155 (19.4)	
Propensity Score:								
Mean $\pm$ SD	0.004 $\pm$ 0.007	0.004 $\pm$ 0.007	0.02 $\pm$ 0.02	<0.0001	0.02 $\pm$ 0.02	0.02 $\pm$ 0.02	0.02 $\pm$ 0.02	0.9936
Age:								
Mean $\pm$ SD	73.3 $\pm$ 5.4	73.3 $\pm$ 5.4	78.8 $\pm$ 6.1	<0.0001	78.8 $\pm$ 6.1	78.9 $\pm$ 6.1	78.8 $\pm$ 6.1	0.6767
Age Group N (%) :								
65–69	81,100 (37.8)	81,005 (37.9)	95 (11.9)	<0.0001	278 (11.6)	183 (11.5)	95 (11.9)	0.9954
70–74	53,074 (24.7)	52,968 (24.8)	106 (13.2)		316 (13.2)	210 (13.1)	106 (13.3)	
75–79	48,304 (22.5)	48,097 (22.5)	207 (25.8)		617 (25.7)	410 (25.7)	207 (25.9)	
80–85	24,666 (11.5)	24,442 (11.4)	224 (27.9)		676 (28.2)	452 (28.3)	224 (28.0)	
85	7578 (3.5)	7408 (3.5)	170 (21.2)		510 (21.3)	343 (21.5)	167 (20.9)	
Race								
White	196,656 (91.6)	195,9947 (91.6)	709 (88.4)	0.001	2123 (88.6)	1417 (88.7)	706 (88.4)	0.8205
Other	18,066 (8.4)	17,973 (8.4)	93 (11.6)		274 (11.4)	181 (11.3)	93 (11.6)	
Charlson Score								
0–1	201,611 (93.9)	200,986 (94.0)	625 (77.9)	<0.0001	1866 (78.7)	1261 (78.9)	625 (78.2)	0.8058
2	10,043 (4.7)	9945 (4.7)	98 (12.2)		296 (12.4)	198 (12.4)	98 (12.3)	
3	3068 (1.4)	2989 (1.4)	79 (9.9)		215 (9.0)	139 (8.7)	76 (9.5)	

Table 2.

Short-term outcomes following pelvic organ prolapse surgery among community-dwelling individuals and nursing home residents.

Characteristics	All Subjects	Community-dwelling	Nursing Home	P value
Length of hospital stay, Mean $\pm$ SD	2.4 $\pm$ 3.6	2.1 $\pm$ 2.7	3.3 $\pm$ 4.7	<.0001
Any complication, N (%)	182 (7.6)	61 (3.8)	121 (15.1)	<.0001
Number of complications, N (%)				
1–2	138 (5.8)	49 (3.1)	89 (11.74)	<.0001
3	44 (1.8)	12 (0.8)	32 (4.0)	
Individual complications, N (%)				
Complications secondary to anesthesia	2 (0.1)	2 (0.1)	0 (0.0)	0.3171
Postoperative hemorrhage	16 (0.7)	5 (0.3)	11 (1.4)	0.0026
Wound complication	1 (0.04)	0 (0.0)	1 (0.1)	0.1572
Cardiovascular	43 (1.8)	14 (0.9)	29 (3.6)	<.0001
Delirium	3 (0.1)	0 (0.0)	3 (0.4)	.0046
Nervous system complication, postoperative shock	13 (0.5)	8 (0.5)	5 (0.6)	0.6941
Infection	76 (3.2)	19 (1.2)	57 (7.1)	<.0001
Acute renal failure, postoperative renal complications	29 (1.2)	6 (0.4)	23 (2.9)	<.0001
Pulmonary	182 (7.6)	61 (3.8)	121 (15.1)	<.0001
Deep venous thrombosis/pulmonary embolism	2 (0.08)	1 (0.1)	21(0.3)	0.6169

Table 3.

Relative risk of short- and long-term outcomes for nursing home residents (compared to community-dwelling older adults) adjusted for procedure type, age, race, Charlson score, and year.

	Basic Statistics		Multivariate Model	
	Observed N (%)	Event # (%)	RR & 95% CI	P value
Hospital length of stay ≥ 3 days	1598 (66.7)	297 (18.6)	Ref	<.0001
	799 (33.3)	311 (38.9)	2.1 (1.8 – 2.4)	
30-day complication	1598 (66.7)	61 (3.8)	Ref	<.0001
	799 (33.3)	121 (15.1)	3.9 (2.9 – 5.3)	
1-year mortality	1598 (66.7)	51 (3.2)	Ref	<.0001
	799 (33.3)	89 (11.1)	3.5 (2.5 – 4.8)	