Original Research

Association Between Concomitant Hysterectomy and Repeat Surgery for Pelvic Organ Prolapse Repair in a Cohort of Nearly 100,000 Women

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OBJECTIVE: To evaluate the association of hysterectomy at the time of pelvic organ prolapse (POP) repair with the risk of undergoing subsequent POP surgery in a large population-based cohort.

METHODS: Data from the California Office of Statewide Health Planning and Development were used in this retrospective cohort study to identify all women who underwent an anterior, apical, posterior or multiple compartment POP repair at nonfederal hospitals between January 1, 2005, and December 31, 2011, using Current Procedural Terminology and International Classification of Diseases, 9th Revision procedure codes. Women with a diagnosis code indicating prior hysterectomy were excluded, and the first prolapse surgery during the study period was considered the index repair. Demographic and surgical characteristics were explored for associations with the primary outcome of a repeat POP surgery. We compared reoperation rates for recurrent POP between patients who did compared with those who did not have a hysterectomy at the time of their index POP repair.

RESULTS: Of the 93,831 women meeting inclusion criteria, 42,340 (45.1%) underwent hysterectomy with index POP repair. Forty-eight percent of index repairs involved multiple compartments, 14.0% included mesh, and 48.9% included an incontinence procedure. Mean follow-up was 1,485 days (median 1,500 days). The repeat POP surgery rate was lower in those patients in whom hysterectomy was performed at the time of index POP repair, 3.0% vs 4.4% (relative risk [RR] 0.67, 95% CI 0.62–0.71). Multivariate modeling revealed that hysterectomy was associated with a decreased risk of future surgery for anterior (odds ratio [OR] 0.71, 95% CI 0.64–0.78), apical (OR 0.76, 95% CI 0.70–0.84), and posterior (OR 0.69, 95% CI 0.65–0.75) POP recurrence. The hysterectomy group had increased lengths of hospital stay (mean 2.2 days vs 1.8 days, mean difference 0.40, 95% CI 0.38–0.43), rates of blood transfusion (2.5% vs 1.5, RR 1.62, 95% CI 1.47–1.78), rates of perioperative hemorrhage (1.5% vs 1.1%, RR 1.32, 95% CI 1.18–1.49), rates of urologic injury or fistula (0.9% vs 0.6%, RR 1.66, 95% CI 1.42–1.93), rates of infection or sepsis (0.9% vs 0.4%, RR 2.12, 95% CI 1.79–2.52), and rate of readmission for an infectious etiology (0.7% vs 0.3%, RR 2.54, 95% CI 2.08–3.10) as compared with those who did not undergo hysterectomy.

CONCLUSION: We demonstrate in a large population-based cohort that hysterectomy at the time of prolapse repair is associated with a decreased risk of future POP surgery by 1–3% and is independently associated with higher perioperative morbidity. Individualized risks and benefits should be included in the discussion of POP surgery.

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Pelvic organ prolapse (POP) is a common condition that annually results in 300,000 surgical procedures in U.S. women[1,2] with recurrences occurring in as many as 30% of repairs.[1,3,4] As a result of the high prevalence of POP, there is great interest in not only defining the risk factors for developing POP, but also understanding who will undergo future POP surgery after index repair failure. Although the risk factors for primary prolapse are well defined including parity, advanced age, and obesity, the risk factors for recurrent prolapse are less clear. This knowledge gap was recently highlighted in a systematic review suggesting preoperative prolapse stage is the only well-documented risk factor for recurrent prolapse.[5]

The relationship between hysterectomy and POP is complicated, resulting in confusion for patients and health care providers alike. Historically, hysterectomy has been considered a mainstay in the surgical treatment of POP, but the data exploring its effect are surprisingly limited. The published literature regarding an association between hysterectomy and prolapse is inconsistent, with some investigations demonstrating equivalent rates of reoperation for prolapse whether hysterectomy is performed or not[6] and others demonstrating a lower recurrent prolapse rate when hysterectomy is included in the prolapse repair.[7,8] Although this is somewhat affected by the decision to perform an apical suspension at the time of POP repair, even this is not entirely clear. Further confusion has arisen as a result of the fact that hysterectomy performed for a nonprolapse indication is considered a strong risk factor for the development of POP.[9,10] Nearly all of these studies have characteristics that limit the generalizability of their results, including small sample size, short follow-up, or single-institution cohort design.

There is a renewed interest in POP procedures without hysterectomy likely as a result of a multitude of factors, including a desire for minimally invasive surgery, preservation of fertility, and the increasing adoption of uterine-sparing treatments of other gynecologic conditions such as abnormal uterine bleeding and leiomyomas. Despite the importance of choosing to perform hysterectomy during POP repair, there are no national guidelines to aid patients or practitioners in this surgical decision-making. Therefore, a clearer understanding of the effect of hysterectomy on POP repair is crucial. For this reason, we sought to determine the association of hysterectomy at the time of index POP repair with future surgery for recurrent POP in a large population-based study. We hypothesized that hysterectomy would be associated with a decreased risk of repeat surgery for recurrent POP.

MATERIALS AND METHODS

With approval from the California Protection of Human Subjects (institutional review board exempt), data from the Office of Statewide Health Planning and Development for the state of California were used in this retrospective cohort study to identify all women who underwent an index anterior, apical, or posterior POP repair (including multicompartment repairs) at nonfederal hospitals in the state of California between January 1, 2005, and December 31, 2010 (repeat POP repairs were identified through December 31, 2011, such that each patient had at least 1 year of follow-up). The Office of Statewide Health Planning and Development is a state office that collects, analyzes, and publishes data in regard to health care with the aim to maintain quality. California-licensed hospitals are required to submit reports to the Office of Statewide Health Planning and Development, which is how the data are derived. Data reported to the Office of Statewide Health Planning and Development office are screened for quality. Any record found to have an invalid entry or to contain incomplete or illogical data is deemed erroneous and a hospital's data must have an error rate of under 2.0% to be accepted.[11] In the Office of Statewide Health Planning and Development data sets, each patient has a unique identifier that allows longitudinal follow-up between encounters. The patient discharge and ambulatory surgery data sets code for unique inpatient and ambulatory surgery visits, respectively, and together cover every single nonfederal surgical encounter (non–Veterans' Affairs, Veterans' Affairs) within the state of California. Each encounter includes up to 20 surgical procedure codes (the ambulatory surgery data set uses Current Procedural Terminology, and the patient discharge data set uses International Classification of Diseases, 9th Revision procedure codes), which represent any procedures performed in that encounter. The data sets also include up to 25 associated diagnosis codes (International Classification of Diseases, 9th Revision) pertaining to the admission diagnosis, procedure diagnosis, and medical history. Additional information available in the patient discharge and ambulatory surgery data sets includes demographics (race, payer status), facility location, and home zip code.

Pelvic organ prolapse repair was defined as cystocele, paravaginal defect, rectocele, enterocele, or uterine prolapse repair (Appendix 1, available online at http://links.lww.com/AOG/B159). We identified all women who had mesh placed using Current Procedural Terminology 57267 for outpatient

procedures and International Classification of Diseases, 9th Revision procedure codes that mentioned a graft or prosthesis for the inpatient group. We also identified those who had a concomitant incontinence procedure. Because the decision to perform hysterectomy is multifactorial, we identified diagnosis codes for uterine conditions associated with the majority of hysterectomies in the United States such as leiomyoma, abnormal uterine bleeding, and endometriosis.[12]

Women were excluded from the cohort if 1) a diagnosis code indicating prior hysterectomy was present at the time of index POP repair, 2) the follow-up time was less than 12 months, 3) the index procedure included colpocleisis because obliterative procedures are considered a different category than reconstructive, and 4) the index procedure included concomitant prolapse graft complication.

Our primary outcome was a subsequent surgical procedure for POP repair after index repair during the study period (repeat POP repair). Women were categorized as having subsequent POP surgery if they had at least one future encounter with a POP procedure code after their index procedure. To identify subsequent POP surgery, we used the same procedure codes used to identify index POP repair, also adding the colpocleisis procedure. The compartment or compartments of the subsequent POP repair were identified as well as if hysterectomy was performed. Diagnosis of benign uterine pathology was noted for subsequent repair with hysterectomy in the same manner as was done for index repairs. Secondary outcomes included perioperative factors such as length of stay, blood transfusion, perioperative hemorrhage, urologic injury, fistula, infection or sepsis, and readmission for an infectious etiology when a diagnosis occurred within 30 days of surgery.

We performed univariate analysis of the demographic and surgical characteristics of women who underwent hysterectomy at the time of index POP repair compared with those who did not. Separate univariate analysis evaluated the compartment of index repair and rate of additional surgery. This was further subdivided by compartment of subsequent surgery and whether hysterectomy was performed at index repair. We used the χ^2 test for categorical comparisons and the Student t test for continuous variables.

Multivariate analysis was performed using three distinct logistic regression models (one for each compartment of repeat surgery: anterior, apical, or posterior). The models estimated the risk of repeat surgery for that individual compartment with the patient and surgical characteristics serving as the independent variables. This resulted in separate models for the risk of additional anterior, apical, or posterior POP surgery. Independent variables included individual demographics such as age, race, payer status and comorbidities, and surgical characteristics of the index POP repair such as compartment of repair, mesh augmentation, concomitant incontinence procedure, and concomitant hysterectomy. To explore whether the observed trends persisted with long-term follow-up, Kaplan-Meier curves were constructed to explore the long-term repeat surgery rates by compartment of index repair and whether hysterectomy was performed.

Finally, we performed three separate sensitivity analyses to address possible confounders. The first was repeating our analysis after excluding women with a non-POP uterine pathology diagnosis. This was performed because uterine pathology is a potential confounder driving the decision to pursue surgery. In other words, a less severe POP may be surgically repaired because a woman elects to undergo surgery primarily for the uterine pathology. The second was repeating our analysis after excluding all abdominal hysterectomies. This was performed to address abdominal approach as a potential confounder for more significant prolapse. Abdominal approach POP repair cannot be identified by POP procedure code alone as a result of limitations in coding. However, hysterectomy codes include approach (abdominal or vaginal) and were therefore used for this sensitivity analysis. For the third sensitivity analysis we repeated our analysis including only those women with at least 5 years of follow-up. This analysis was performed to address time as a potential confounder because POP is generally considered a chronic process that may be more likely to require surgery over time. In a further effort to reduce bias, propensity scoring was performed by the nearest neighbor methods (Appendix 2, available online at http://links.lww.com/AOG/B159). Cases with and without hysterectomy were matched to their nearest neighbor by all the other variables that were included in our multivariate modeling. There was a 43.0% improvement in mean distance between the groups after matching. Repeating the analysis with these matched groups did not alter the results (Appendix 2, http://links.lww.com/AOG/B159).

All statistical analysis was performed with R 3.5.0. A two-sided P value of $<.05$ was taken to indicate statistical significance.

RESULTS

A total of 110,329 women underwent POP repair during the study period. Of these, 1,768 were excluded for a history of hysterectomy before index

POP repair and 14,730 were excluded for follow-up less than 1 year. Our final cohort of 93,831 women represented multiple racial groups and payer types (Table 1). The mean follow-up was 1,485 days (median 1,500 days).

Each compartment of repair was well represented, with 44% of the cohort undergoing single-compartment repairs and the remaining 56% undergoing multicompartment repairs (Table 1). A total of 45.1% of women underwent hysterectomy at the time of their index prolapse surgery, and overall 14.0% of women underwent a mesh-augmented repair and 48.9% underwent a concurrent incontinence procedure (Table 1). There were differences in baseline characteristics between the uterine preservation and hysterectomy groups. Both the use of mesh and a concomitant incontinence procedure were more common in the uterine preservation group (17.6% vs 9.6% and 54.2% vs 42.6%, respectively, $P<.001$).

A total of 3,545 women (3.8%) underwent surgery for recurrent POP during the study period with a mean time to repeat surgery of 1.9 years (SD 1.5 years). The overall rate of additional POP surgery in those who underwent hysterectomy at the time of their index repair was lower than those who did not undergo hysterectomy (3.0% vs 4.4%, relative risk [RR] 0.67; 95% CI 0.62–0.71, $P<.001$). This trend was consistent regardless of the compartment of index repair or the compartment of subsequent surgery (Table 2). Of the 2,286 women who underwent a subsequent POP surgery after a nonhysterectomy index POP repair, 514 (22.4%) underwent a hysterectomy at the time of the subsequent POP surgery and only 119 (5.2%) had a concomitant diagnosis suggesting uterine pathology.

In regard to the secondary outcomes, those who underwent hysterectomy at the time of their index prolapse repair had longer lengths of hospital stay (mean 2.2 days vs 1.8 days, mean difference 0.40, 95% CI 0.38–0.43, $P<.001$) and higher rates of blood transfusion (2.5% vs 1.5, RR 1.62, 95% CI 1.47–1.78, $P<.001$), rates of perioperative hemorrhage (1.5% vs 1.1%, RR 1.32, 95% CI 1.18–1.49,

Table 1. Demographic and Surgical Characteristics by Concomitant Hysterectomy

Characteristic	Total (N=93,831)	No Hysterectomy (n=51,491)	Hysterectomy (n=42,340)	*P*
Age (y)	58.0±13.3	59.8±13.7	55.8±12.5	<.001
Race				
White	60,682 (64.7)	34,870 (67.7)	25,812 (61.0)	
Black	2,154 (2.3)	1,133 (2.2)	1,021 (2.4)	
Hispanic	14,690 (15.6)	8,120 (15.8)	6,570 (15.5)	
Asian	4,479 (4.8)	1,863 (3.6)	2,616 (6.2)	
Other	11,826 (12.6)	5,505 (10.7)	6,321 (14.9)	<.001
Payer				
Private	57,309 (61.1)	29,489 (57.3)	27,820 (65.7)	
Medicare	28,893 (30.8)	18,598 (36.1)	10,295 (24.3)	
Medicaid	5,978 (6.4)	2,533 (4.9)	3,445 (8.1)	
Other	1,651 (1.7)	871 (1.7)	780 (1.9)	<.001
Compartment of repair				
Anterior	65,060 (69.3)	37,161 (57.1)	27,899 (42.9)	<.001
Apical	40,326 (43.0)	18,839 (46.7)	21,487 (53.3)	<.001
Posterior	58,487 (62.3)	31,841 (54.4)	26,646 (45.6)	<.001
Multiple	52,750 (56.2)	27,453 (52.0)	25,297 (48.0)	<.001
Comorbidity				
Coronary artery disease	6,497 (6.9)	4,464 (8.7)	2,003 (4.7)	<.001
Hypertension	33,120 (35.3)	20,144 (39.1)	12,976 (30.6)	<.001
Diabetes mellitus	9,760 (10.4)	5,688 (11.0)	4,072 (9.6)	<.001
Obesity	2,610 (2.8)	1,564 (3.0)	1,046 (2.5)	<.001
Index surgery				
Mesh use	13,140 (14.0)	9,074 (17.6)	4,056 (9.6)	<.001
Incontinence procedure	45,927 (48.9)	27,894 (54.2)	18,033 (42.6)	<.001
Perioperative complication				
Transfusion	1,831 (2.0)	772 (1.5)	1,059 (2.5)	<.001
Hemorrhage	1,201 (1.3)	566 (1.1)	635 (1.5)	<.001
Infection	571 (0.6)	209 (0.4)	362 (0.9)	<.001
Readmission	447 (0.5)	146 (0.3)	301 (0.7)	<.001
Urologic injury or fistula	693 (0.7)	296 (0.6)	397 (0.9)	<.001

Data are mean±SD or n (%) unless otherwise specified.

Table 2. Rate of Reoperation by Repair Compartment at Index Surgery, Recurrence Compartment, and Concomitant Hysterectomy

	Subsequent Surgery			
Index Surgery	Anterior	Apical	Posterior	More Than 1 Compartment
Anterior				
No hysterectomy (n=37,161)	799 (2.2)	968 (2.6)	804 (2.2)	671 (1.8)
Hysterectomy (n=27,899)	413 (1.5)	552 (2.0)	375 (1.3)	355 (1.3)
Apical				
No hysterectomy (n=18,839)	422 (2.2)	618 (3.3)	411 (2.2)	366 (1.9)
Hysterectomy (n=21,487)	279 (1.3)	414 (1.9)	282 (1.3)	246 (1.1)
Posterior				
No hysterectomy (n=31,841)	637 (2.0)	782 (2.5)	575 (1.8)	507 (1.6)
Hysterectomy (n=26,646)	391 (1.5)	481 (1.8)	289 (1.1)	299 (1.1)
More than 1 compartment				
No hysterectomy (n=27,438)	593 (2.2)	767 (2.8)	550 (2.0)	497 (1.8)
Hysterectomy (n=25,292)	370 (1.5)	483 (1.9)	301 (1.2)	307 (1.2)

Data are n (%).

$P<.001$), rates of urologic injury or fistula (0.9% vs 0.6%, RR 1.66, 95% CI 1.42–1.93, $P<.001$), rates of infection or sepsis (0.9% vs 0.4%, RR 2.12, 95% CI 1.79–2.52, $P<.001$), and rate of readmission for an infectious etiology (0.7% vs 0.3%, RR 2.54, 95% CI 2.08–3.10, $P<.001$) compared with those who did not undergo hysterectomy (Table 1).

Multivariate modeling demonstrated that hysterectomy was associated with decreased risk of repeat surgery even when adjusting for several individual and surgical factors (Table 3). Specifically, adjusting for age, race, insurance type, medical comorbidities, mesh use, and concurrent incontinence procedure, the analysis revealed that regardless of the compartment of index repair, hysterectomy was associated with a decreased risk of future surgery for POP recurrence in anterior (odds ratio [OR] 0.71, 95% CI 0.64–0.78), apical (OR 0.76, 95% CI 0.70–0.84), and posterior compartments (OR 0.69, 95% CI 0.65–0.75). Multivariate modeling revealed other interesting associations. There was a statistically significant association between race and reoperation rates with Asian, black, and Hispanic women having a reduced odds of requiring repeat surgery as compared with white women (Table 3). Mesh-augmented repairs reduced the relative odds of requiring repeat surgery for the anterior compartment, whereas increasing age was associated with increased odds of requiring repeat surgery (Table 3).

Of the 42,340 women undergoing hysterectomy at their index repair, 15,381 (36.3%) had a non-POP uterine pathology diagnosis. Women with a non-POP uterine pathology diagnosis had a lower rate of repeat POP surgery than women with a POP diagnosis alone (2.4% vs 3.3%, OR 0.73, 95% CI 0.64–0.82, $P<.001$). Sensitivity analysis excluding women with a non-POP uterine pathology diagnosis confirmed a higher repeat surgery rate among women who did not undergo hysterectomy as compared with those who did (4.4% vs 3.3%, OR 1.32, 95% CI 1.22–1.43, $P<.001$). Further sensitivity analysis excluding all abdominal hysterectomies (13,730) again demonstrated higher repeat surgery rates in the uterine preservation group than in the hysterectomy group (4.4% vs 3.0, OR 0.68, 95% CI 0.63–0.73, $P<.001$).

Repairs with concomitant hysterectomy had lower repeat surgery rates up to 7 years after the index repair (Fig. 1). A sensitivity analysis of the 32,616 women who had at least 5 years of follow-up revealed similar trends. In this cohort, the overall repeat surgery rate was lower if hysterectomy was performed at the time of any type of index compartment of repair: 8.6% vs 12.4% (RR 0.69, 95% CI 0.64–0.74), 9.0% vs 15.0% (RR 0.59, 95% CI 0.53–0.65), and 8.1% vs 11.3% (RR 0.72, 95% CI 0.66–0.78) for anterior, apical, and posterior repairs, respectively (P value all $<.001$).

DISCUSSION

We find in this large population-based cohort study that hysterectomy at the time of POP repair is associated with decreased risk of repeat POP surgery, even when controlling for patient and surgical factors. It should be noted, however, that this translates to a modest 1–3% difference in risk and, as with other studies, hysterectomy was associated with increased morbidity.[7]

Our results should be considered in the context of existing literature. Although one recent meta-analysis

Table 3. Multivariate Analysis of Factors Associated With Risk of Additional Pelvic Organ Prolapse Surgery

Characteristics	Subsequent Surgery		
	Anterior	Apical	Posterior
Index surgery			
Hysterectomy	0.71 (0.64–0.78)*	0.76 (0.70–0.84)*	0.69 (0.65–0.75)*
Mesh use	0.79 (0.67–0.92)*	0.92 (0.81–1.05)	0.91 (0.82–1.00)
Incontinence procedure	0.87 (0.79–0.96)*	0.95 (0.87–1.04)	0.93 (0.87–1.00)
Compartment			
Anterior	1.16 (1.04–1.31)*	1.11 (1.01–1.23)*	1.09 (1.01–1.18)*
Apical	1.04 (0.93–1.16)	1.25 (1.13–1.37)*	1.12 (1.04–1.21)*
Posterior	0.96 (0.87–1.06)	0.86 (0.79–0.94)*	0.85 (0.79–0.91)*
Age (y)†	1.01 (1.01–1.02)*	1.02 (1.01–1.02)*	1.01 (1.01–1.01)*
Race			
White	Reference	Reference	Reference
Black	0.62 (0.41–0.90)*	0.59 (0.41–0.82)*	0.61 (0.46–0.78)*
Hispanic	0.86 (0.74–0.99)*	0.61 (0.52–0.70)*	0.70 (0.63–0.78)*
Asian	0.54 (0.40–0.72)*	0.54 (0.41–0.69)*	0.54 (0.44–0.66)*
Other	0.85 (0.72–1.00)	0.80 (0.69–0.92)*	0.81 (0.72–0.90)*
Payer			
Medicare	Reference	Reference	Reference
Private	1.20 (1.05–1.38)*	1.35 (1.20–1.53)*	1.30 (1.18–1.43)*
Medicaid	1.06 (0.82–1.37)	1.04 (0.81–1.32)	1.10 (0.91–1.31)
Other	1.21 (0.80–1.77)	1.04 (0.69–1.50)	1.09 (0.80–1.44)
Comorbidity			
Coronary artery disease	0.95 (0.79–1.14)	0.84 (0.71–1.00)	1.02 (0.85–1.23)
Hypertension	1.28 (1.15–1.43)*	1.48 (1.34–1.63)*	1.42 (1.31–1.53)*
Diabetes mellitus	1.11 (0.95–1.29)	1.10 (0.96–1.26)	1.06 (0.95–1.18)
Obesity	1.08 (0.81–1.42)	1.14 (0.89–1.44)	1.18 (0.97–1.42)

Data are odds ratio (95% CI).
* Statistical significance ($P<.05$).
† Age was taken as a continuous variable in modeling, so for each year increase in age, the odds of repeat surgery increased by the expressed relative odds in that column.

concluded that hysterectomy may be associated with reduced risk of repeat surgery, another larger meta-analysis reported hysterectomy was not associated with a protective effect.[7,8] Despite the differing conclusions, it is important to note that a high proportion of the studies included in the meta-analysis report a protective effect of hysterectomy and none reports a protective effect in uterine preservation groups. Our results are also notable for a low rate of recurrent prolapse surgery of 3.8% overall and 10.9% in those with 5-year follow-up in stark contrast to often-quoted studies estimating a long-term risk of repeat prolapse surgery of up to 30%.[1] However, these appear to be the outliers among the large number of investigations within the literature. In fact, the majority of studies report similar repeat surgery rates as ours.[8,13,14]

Our findings contribute valuable information to the discussion of risk factors for recurrence after prolapse surgery. Although age and body mass index are known risk factors for primary POP, the strongest risk factor for POP recurrence reported in literature is preoperative stage.[5,15] We find that women with POP as the only indication for surgery have a higher repeat surgery rate than those with other uterine pathology, possibly signifying this group had more severe POP. In addition to hysterectomy status, we find that white race is associated with an increased risk of repeat surgery. Several studies across multiple specialties have reported poorer outcomes in black and Hispanic women and those with indigent payer types.[16–27] This suggests that the racial differences in reoperation rates for POP repair may be more attributable to subtler treatment-seeking behavior or possibly underlying biological differences rather than being driven by socioeconomic status or the related issue of access to medical care.

There are limitations of our study worthy of mention. First, as with any administrative data set, we are unable to examine granular risk factors such as particular physician characteristics, including board certification, certain medical comorbidities, and preoperative physical examination. As a result of the limitations of coding, we were unable to stratify any procedures by surgical approach except hysterectomy.

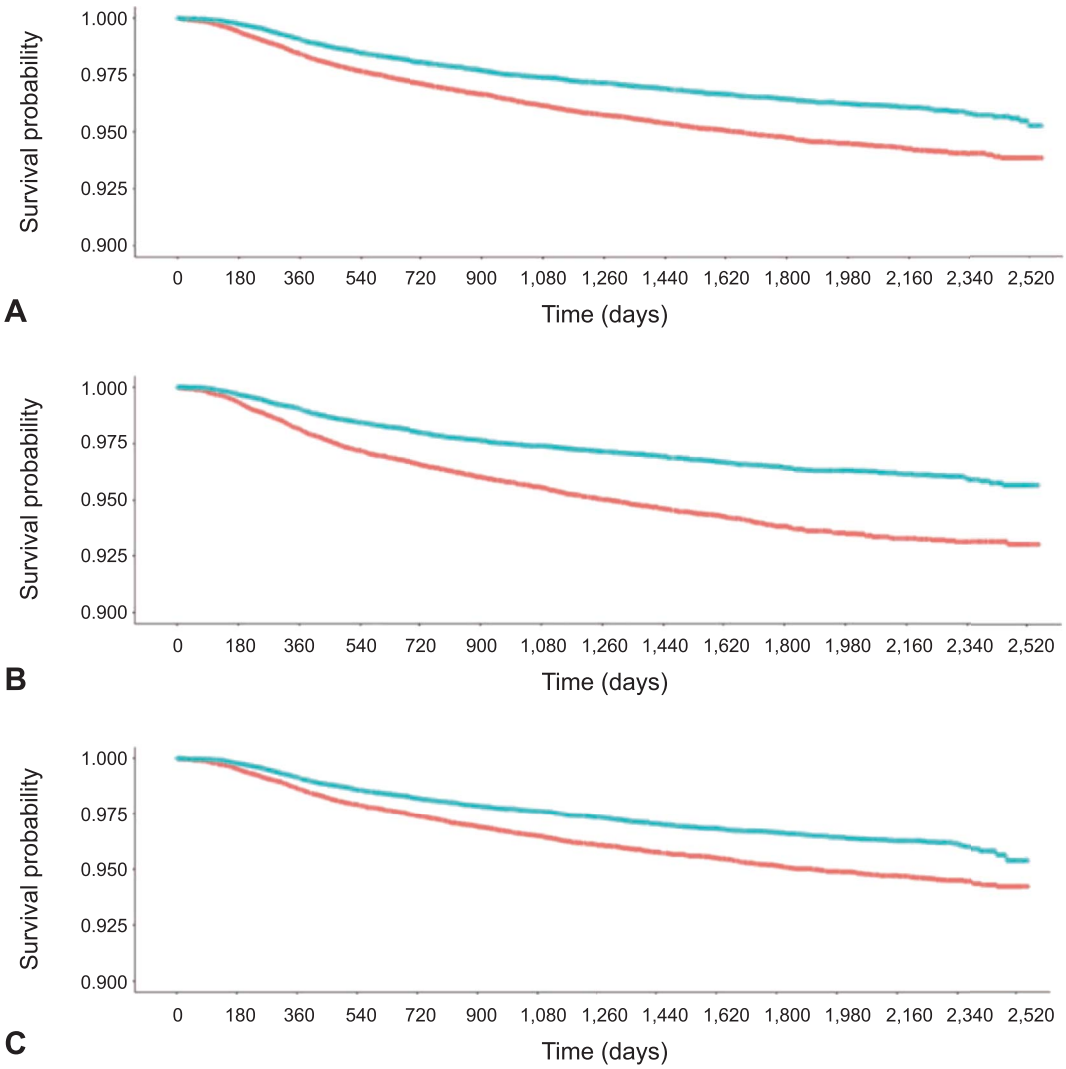

Fig. 1. Repeat prolapse surgery rates over time by index repair compartment. Anterior compartment repeat surgery rates (**A**), apical compartment repeat surgery rates (**B**), and posterior compartment repeat surgery rates (**C**). *Red lines* indicate nonhysterectomy index repair, and *blue lines* indicate hysterectomy at the time of index repair.

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However, our sensitivity analysis demonstrates this limitation is unlikely to affect our conclusion. Second, our primary outcome is defined as surgery rather than prolapse recurrence, limiting the conclusions that can be drawn regarding failure of POP surgery by physical examination. Third, our data include all California hospitals excluding Veterans' Affairs facilities; therefore, if women transferred their care to a Veterans' Affairs facility, they would not be captured. In addition, our cohort has a mean follow-up of 4.1 years and therefore our results may not be applicable to recurrent surgery beyond that timeframe. However, even when only considering women with at least 5 years of follow-up, the hysterectomy group continued to outperform the nonhysterectomy cohort (8.6% reoperation rate vs 12.9%, respectively). Finally, although the association is statistically significant, the value lies within the range of potential bias for cohort studies (RR 0.5–2.0).[28] Although we made efforts to address this with our large sample size, control of several confounders, and sensitivity analysis, this limitation is inherent to this study design.

Despite these limitations, our study has many notable strengths and builds on existing knowledge by providing results in a much larger cohort than prior studies.[7] Our use of this large population-based cohort allows us to describe actual reoperation rates, which we feel is a more accurate reflection of the statewide

current care in contrast to smaller series. The Office of Statewide Health Planning and Development data sets have another advantage in that all payer types are included, and all repeat surgeries are captured even if the patient moves to a new facility (non–Veterans' Affairs, in California). To aid in the discussion of the risks and benefits of concurrent hysterectomy, we also include perioperative factors including length of stay, hemorrhage, infection, and urologic injury. Additionally, although many studies are limited by short follow-up times, ours benefits from longer term follow-up. Long-term surgical outcome data are increasingly relevant because the average female life expectancy is 81 years, therefore increasing the exposure time and risk of recurrence.[29]

Based on our results, women considering surgery for symptomatic prolapse can be counseled on the association between hysterectomy at the time of POP repair and the risk of future prolapse surgery. This difference in repeat surgery is small and must be weighed against associations between hysterectomy and higher perioperative morbidity, bleeding, and longer hospital stay. Additional research is recommended to further define additional risk factors for prolapse recurrence and which women are most likely to benefit from hysterectomy.

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