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Laparoscopic inguinal hernia repair in women: Trends, disparities, and postoperative outcomes

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ABSTRACT

Introduction: This study analyzed trends in laparoscopic inguinal hernia repair over time, rates of laparoscopic repair in women, and subsequent postoperative outcomes.
Methods: Data for 237,503 patients undergoing repair of an initial, reducible inguinal hernia were analyzed using the National Surgical Quality Improvement Program (NSQIP) database for years 2006–2017. Data were analyzed by univariate and multivariate analysis.
Results: Since 2006, there was an increased proportion of laparoscopic inguinal hernia surgeries, from 20.49% in 2006 to 36.36% in 2017 ($p < .001$). The percentage of women with bilateral inguinal hernias that underwent laparoscopic repair was less than the percentage of men (31.58% vs. 41.43%, $p < .001$). Based on multivariate analysis, women were less likely to have laparoscopic hernia repair (OR 0.74, CI 0.71–0.76). Postoperative complications were overall low.
Conclusion: A greater proportion of inguinal hernia repairs are performed laparoscopically. Women with bilateral inguinal hernias are more likely than men to undergo open rather than laparoscopic inguinal hernia repair.

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Introduction

Over 20 million inguinal hernia repairs occur annually.[1] In 2003, 800,000 groin hernia repairs were performed in the United States.[2] For women, the lifetime risk of inguinal hernias is 3%.[3] The goal of elective hernia repair is to prevent hernia-related complications, especially bowel compromise. In one study, the risk of complication with delayed hernia repair was 2.4%.[4]

General indications for laparoscopic inguinal hernia repair include management of bilateral inguinal hernias or repair of recurrent inguinal hernias after open surgery.[5] There are two methods of laparoscopic inguinal hernia repair - the transabdominal preperitoneal approach (TAPP) and the totally extraperitoneal (TEP) approach.[6] The laparoscopic approach proves to be a more efficient way to evaluate for femoral and obturator hernias compared to the Lichtenstein repair. It is especially important to evaluate the femoral space endoscopically in women given the increased incidence of femoral hernias in this population.[7] The purpose of this study is to evaluate trends in inguinal hernia repair using the NSQIP database and to analyze rates of laparoscopic repair in women and postoperative outcomes.

Methods

The American College of Surgeon's National Surgical Quality Improvement Program Participant User File (ACS-NSQIP PUF) database was used to identify patients who underwent elective repair of an inguinal hernia between 2006 and 2017. Current Procedural Terminology codes for elective open inguinal hernia repair (49505, 49507, 49520, and 49525) and elective laparoscopic inguinal hernia repair (49650, 49651, and 49659) were used in conjunction with the International Classification of Disease, Ninth and Tenth Revision codes (550.9, K40, K40.00, K40.01, K40.0, K40.1, K40.10, K40.11, K40.2, K40.20, K40.21, K40.3, K40.30, K40.31, K40.4, K40.40, K40.41, K40.9, K40.90, K40.91) to identify all patients who underwent primary management of inguinal hernias. Emergent inguinal hernia repairs were excluded. Postoperative complications and 30-day mortality were reviewed. Major complications were

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Table 1
Demographics.

Characteristics	Total (n = 237, 503)	Laparoscopic (n = 72,286)	Open (n = 165,217)	p-value
Female	19,750 (8.32%)	4837 (6.69%)	14,913 (9.03%)	<.001
Smoker	44,209 (18.61%)	12,616 (17.45%)	31,593 (19.12%)	<.001
Hypertension	87, 810 (36.97%)	23,734 (32.83%)	64,076(38.78%)	<.001
ASA Class				
I	43,967 (18.51%)	15,031 (20.79%)	28,936 (17.51%)	<.001
II	131,981 (55.57%)	42,573 (58.9%)	89,408 (54.12%)	<.001
III	56,903 (23.96%)	13,982 (19.34%)	42,921 (25.98%)	<.001
IV	4081 (1.72%)	630 (0.87%)	3451 (2.09%)	<.001
Diabetes	17,162 (7.23%)	4508 (6.24%)	12,654 (7.66%)	<.001
Age less than 80	218,962 (92.19%)	68,987 (95.44%)	149,975 (90.77%)	<.001
BMI 40+	3052 (1.29%)	910 (1.26%)	2142 (1.3%)	.45
Bilateral inguinal hernias	77,623 (32.68%)	32,743 (45.30%)	44,880 (27.16%)	<.001

defined as the occurrence of one of the following events: superficial, deep and organ space infection, wound dehiscence, prolonged ventilation, pulmonary embolism, deep vein thrombosis, cardiac arrest, urinary tract infection, pneumonia, sepsis, and septic shock. All clinical factors in the ACS-NSQIP database are defined in the user guide. Categorical variables were analyzed by chi-square test and continuous variables with the Student t-test where appropriate. Additionally, multivariate stepwise logistic regression was used to evaluate factors associated with laparoscopic inguinal hernia repair. The variables for the multivariate analysis included female, smoker, diagnosis of bilateral inguinal hernia, hypertension, ASA (1, 2, 3, or 4), diabetic, age less than 80, and BMI over 40. All statistical analyses were performed on SAS 9.4 (SAS Institute, Cary, NC).

Results

We identified 237,503 patients who underwent elective inguinal hernia repair between 2006 and 2017.Of these patients, 19,750 (8.32%) were female. The majority of patients were ASA II (55.57%). A minority of the patients were diabetic (7.23%) or morbidly obese (1.29%). 77,623 patients had bilateral inguinal hernias. 6.69% of the patients undergoing laparoscopic inguinal hernia repair were women (Table 1).

Since 2006, an increased proportion of inguinal hernia repairs were performed laparoscopically (Fig. 1). In 2006, 20.49% of the inguinal hernia surgeries were laparoscopic and 77.13% were open. By 2017, 36.36% of inguinal hernia repairs were laparoscopic whereas 58.73% were open ($p < .001$).

31.58% of women with a preoperative diagnosis of bilateral inguinal hernias underwent laparoscopic repair versus 41.43% of men with this preoperative diagnosis ($p < .001$) (Fig. 3). Multivariate analysis showed that women were less likely to have laparoscopic hernia repair (OR 0.74, CI 0.71-0.76). Smokers (OR 0.86, CI 0.84–0.88) and diabetics (0.94, CI 0.91–0.98) were also less likely. Patients with bilateral inguinal hernias (OR 2.19, CI 2.16–2.24) were more likely to have laparoscopic inguinal hernia repair (Fig. 2).

Postoperative complications were overall low (Tables 2 and 3). After open repair, women experienced more urinary tract infections (0.58% vs. 0.28%, $p < .01$) and surgical site infections (0.53% vs. 0.37%, p=<.01). After laparoscopic repair, women experienced more organ space infections (0.08% vs. 0.02%, $p < .01$), urinary tract infections (0.87 vs. 0.33, $p < .01$), and mortality (0.12% vs. 0.05%, $p = .03$).

Discussion

Our study shows a greater percentage of inguinal hernia repairs are being performed laparoscopically over time; however the majority of repairs are still open. These findings are consistent with previous studies demonstrating increased utilization of minimally invasive surgery for inguinal hernia repair but overall poor penetrance compared to cholecystectomy or appendectomy. One factor

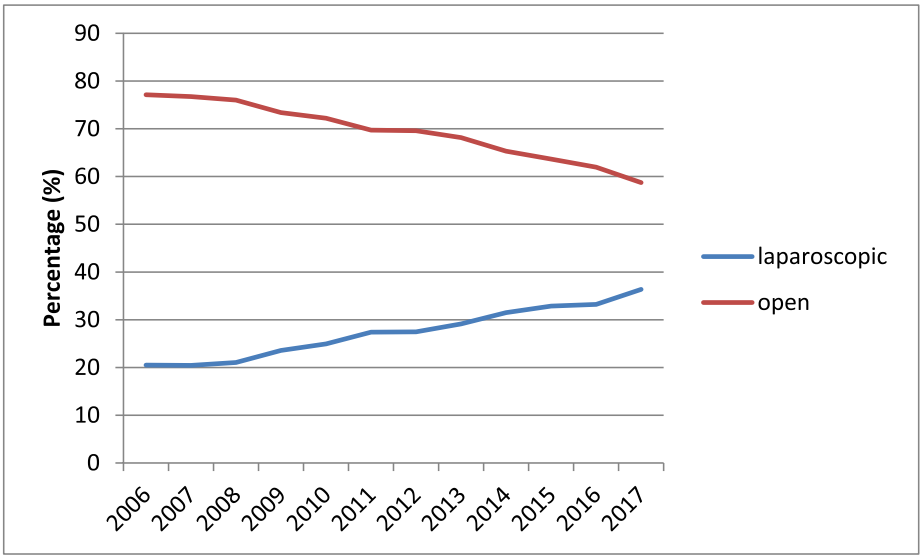

Fig. 1. Trends in open versus laparoscopic elective inguinal hernia repair.

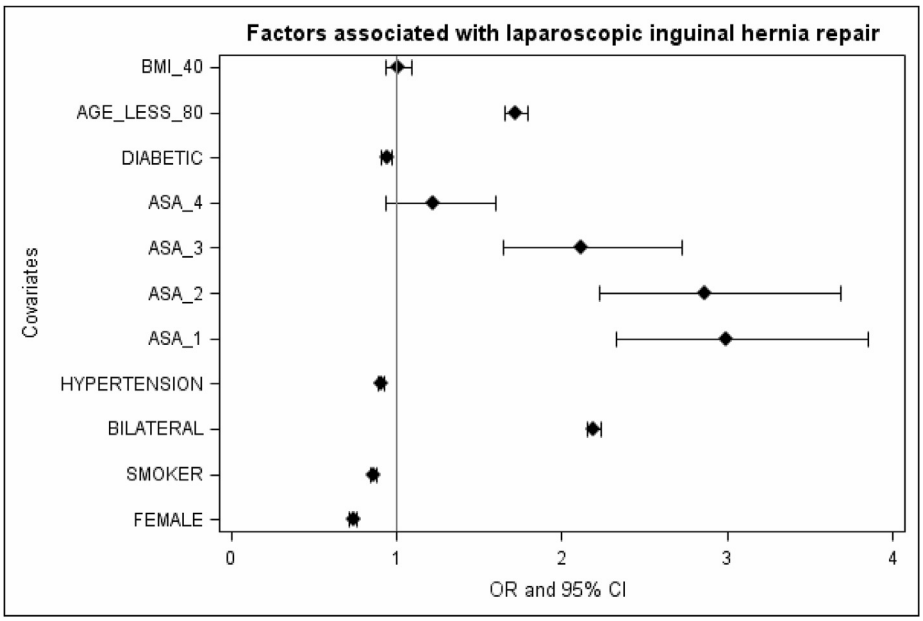

Fig. 2. Factors associated with laparoscopic inguinal hernia repair. "BMI_40" = BMI 40 or greater, "AGE_LESS_80" = patients younger than 80 years old, "BILATERAL" = patients with bilateral inguinal hernias.

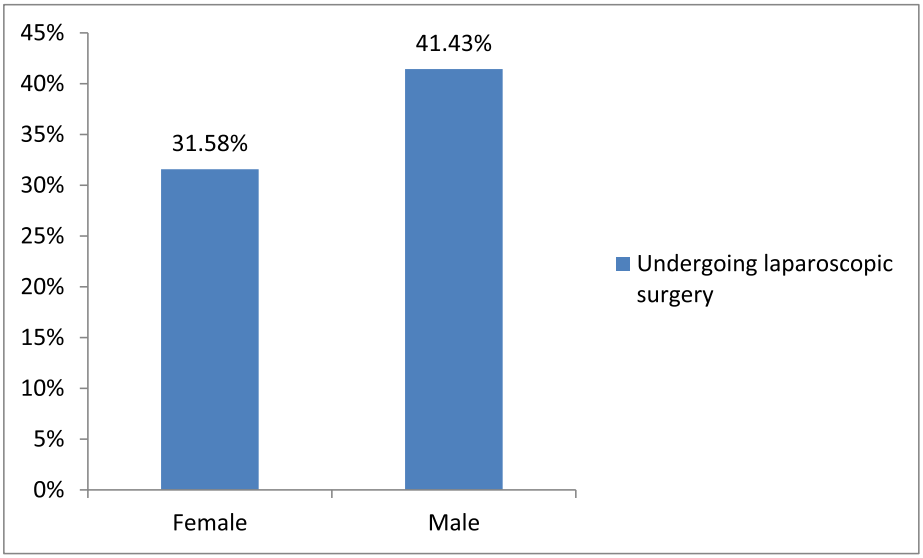

Fig. 3. Comparison by sex of patients undergoing laparoscopic inguinal hernia repair for bilateral inguinal hernias.

Table 2
Postoperative complications following open elective inguinal hernia repair.

Characteristics	Total (n = 165,217)	Female (n = 14,913)	Male (n = 150,304)	P-value
Superficial surgical site infection	0.39%	0.53%	0.37%	.0033
Deep surgical site infection	0.06%	0.08%	0.06%	.43
Wound dehiscence	0.06%	0.06%	0.06%	.83
Organ space infection	0.04%	0.03%	0.05%	.29
Pneumonia	0.15%	0.14%	0.15%	.72
Urinary tract infections	0.31%	0.58%	0.28%	<.001
Bleeding	0.08%	0.05%	0.08%	.24
Pulmonary embolism	0.05%	0.07%	0.05%	.30
Prolonged intubation	0.03%	0.03%	0.04%	.60
Cardiac arrest	0.04%	0.02%	0.04%	.25
DVT	0.09%	0.08%	0.09%	.59
Sepsis	0.11%	0.07%	0.11%	.11
Septic Shock	0.04%	0.02%	0.04%	.28
Mortality	0.11%	0.09%	0.11%	.57
Return to the OR	0.68%	0.75%	0.67%	.24

Table 3
Postoperative complications following laparoscopic elective inguinal hernia repair.

Characteristics	Total (n = 72,286)	Female (n = 4837)	Male (n = 67,449)	P-value
Superficial surgical site infection	0.21%	0.33%	0.20%	.06
Deep surgical site infection	0.02%	0.04%	0.02%	.35
Wound dehiscence	.02%	0.04%	0.01%	.17
Organ space infection	0.02%	0.08%	0.02%	<.001
Pneumonia	0.08%	0.12%	0.08%	.30
Urinary tract infections	0.36%	0.87%	0.33%	<.01
Bleeding	0.11%	0.17%	0.11%	.22
Pulmonary embolism	0.06%	0.04%	0.06%	.67
Prolonged intubation	0.02%	0.04%	0.02%	.45
Cardiac arrest	0.02%	0.02%	0.03%	.84
DVT	0.07%	0.06%	0.07%	.84
Sepsis	0.08%	0.04%	0.08%	.35
Septic Shock	0.02%	0.04%	0.02%	.35
Mortality	0.05%	0.12%	0.05%	.03
Return to the OR	0.57%	0.74%	0.56%	.10

contributing to this trend is the steep learning curve associated with the laparoscopic inguinal hernia repair.[8,9] Furthermore, there is limited access to minimally invasive inguinal hernia surgery based on region.[10]

Women are 3–4 times more likely to have an emergency groin hernia repair.[11] This is partly due to the fact that femoral hernias occur more frequently in women and have higher risk of strangulation. In fact, the International Guidelines for groin hernia management recommend that groin hernia repairs in women be performed laparoscopically in order to avoid missing a femoral hernia.[12] In one study, 41.6% of women who underwent repair of recurrent inguinal hernia repair were actually diagnosed with a femoral hernia on reoperation.[13] This suggests increased misdiagnosis of groin hernias in women and should lower the threshold of performing a laparoscopic repair. A 2019 study by Kockerling et al. supports laparoscopic hernia repair in women on the basis that there are fewer postoperative complications in this population compared to open repair.[14] Despite recent evidence supporting laparoscopic hernia repair in women, our NSQIP analysis showed decreased rates of laparoscopic hernia repair in women with bilateral inguinal hernias than men.

The limitations of this study result from analyzing large administrative data sets. Coding errors occur and may skew findings.[15] Given the NSQIP database is built on partial sampling, there is also the possibility of sampling error.[16] Future studies using different databases may be performed to further evaluate trends, outcomes, and disparities.

Conflicts of interest

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