



## Original Research Article

## Loss of independence after emergency inguinal hernia repair in elderly patients: How aggressive should we be?

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## ABSTRACT

**Background:** Loss of independence (LOI) assesses patient quality of life after surgery and is associated with increased readmission and death. This paper compares LOI among the elderly who received elective versus emergent inguinal hernia repair.

**Methods:** The American College of Surgeons National Surgical Quality Improvement Program (ACS-NSQIP) Participant User Files from 2015 to 2017 were reviewed for inguinal hernia repairs in patients 70-years-old or older. Chi-square analysis, Student t-test, and backwards multivariate logistic analysis were performed appropriately.

**Results:** Patients undergoing elective open or laparoscopic repair were less likely to experience LOI (OR 0.061, CI 0.035–0.106) and (OR 0.052 CI 0.024–0.113), respectively, and they were less likely to experience mortality (OR 0.07, CI 0.026–0.185) and (OR 0.059, CI 0.015–0.229), respectively.

**Conclusions:** Significant debility occurs following emergency inguinal hernia repair in elderly patients. Elective surgery may be indicated more often in order to reduce emergencies and LOI in elderly patients.

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## Introduction

Loss of independence (LOI) is an important measure of assessing the quality of life of patients after surgery. It is a metric described by Berian et al.<sup>1</sup> which evaluates the ability of primarily elderly patients to function independently after surgery, without the need for admission to a nursing home or rehabilitation facility. This measure becomes especially important given the rapidly aging population and the parallel rise increase in the risk inguinal hernia with age.<sup>2,3</sup> Consequently, inguinal hernia repair is one of the most commonly performed surgical procedures in the United States and can be performed with utilizing an open or laparoscopic repair technique.<sup>4–7</sup> Although multiple studies have indicated that there are differences in recovery and post-operative outcomes, both procedures have relatively low complication rates. Therefore, if the hernia is asymptomatic and does not interfere with one's daily life, a number of studies have shown that watchful waiting is a safe option.<sup>8–11</sup> Those who developed symptoms and had the surgery at

a later time than those who initially had the repair, were at no greater risk of operative complications.<sup>9,10</sup>

Current literature encourages watchful waiting in the elderly<sup>12–15</sup>; however, the present study challenges the decision-making process to additionally factor in the decreased quality of life following emergency hernia repair. The current watchful waiting model is based primarily upon the risk of mortality and serious side effects, without factoring in the loss of independence that might occur. Therefore, watchful waiting is currently considered low risk, when in fact, it may ultimately result in worse outcomes for elderly patients. Emergency repair can lead to significant debility in patients with a significant decrease in loss of independence, which is associated with increased readmission and death after discharge.<sup>1,16</sup> Although there are many studies comparing the outcomes of emergent versus elective repair, no study has compared loss of independence in patients undergoing elective versus emergency inguinal hernia repair. The present study utilizes the NSQIP database to evaluate loss of independence among the elderly who either had an elective or emergent inguinal hernia repair.

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## Methods

The American College of Surgeons National Surgical Quality Improvement Program Participant User File (ACS-NSQIP PUF) database was used to identify patients who underwent primary inguinal hernia repair between 2015 and 2017. Current procedural terminology (CPT) codes for laparoscopic inguinal hernia repair (49650 and 49659) and open inguinal hernia repair (49505 and 49525) were used. International Classification of Disease, Ninth Revision codes (550.01, 550.03, 550.11, 550.13, 550.91, and 550.93) and Tenth Revision codes (K40.01, K40.11, and K40.21) were used to eliminate patients undergoing recurrent inguinal hernia repair. Clinically relevant preoperative comorbidities and postoperative events including complications and loss of independence after primary operation were noted and reviewed. Patients were identified as experiencing a loss of independence if they were admitted from home and discharged to a rehabilitation, skilled care (not home), unskilled facility (not home), or a separate acute care facility. Major complications were defined as an occurrence of one of the following events: superficial, deep and organ space infection, wound dehiscence, renal insufficiency, renal failure, prolonged ventilation, pulmonary embolism, deep vein thrombosis, cardiac arrest, stroke, myocardial infarction, urinary tract infection, pneumonia, sepsis, and septic shock. All clinical factors in the ACS-NSQIP database are defined in the user guide.

Patients 70 years and older were included. These patients were further grouped into those who underwent an elective inguinal hernia repair and those who had emergency inguinal hernia repair. Categorical variables were analyzed between the two groups by chi-square test where appropriate. Postoperative complications were evaluated. Backwards multivariate logistic analysis was used to determine mortality and loss of independence within the elderly population. The model included elective open hernia repair, elective laparoscopic hernia repair, gender, black race, Native American race, white race, Hispanic, Asian, Pacific Islander/Native Hawaiian, dyspnea, hypertension, diabetes, chronic obstructive pulmonary disease (COPD), ventilator dependence, ascites, congestive heart failure (CHF), renal failure, end-stage renal disease, cancer, open wound/wound infection, steroid use for a chronic condition, preoperative weight loss, bleeding disorder, and preoperative packed red blood cell transfusion and the c-statistics was 0.78 for both analyses.

Failure to rescue, which was first defined by Silber et al., in 1992, is defined as death in a patient after a complication from surgery. It measures a hospital's ability to prevent death after a surgical complication and is therefore used as a marker of surgical quality. Failure to rescue is calculated by dividing the number of 30-day deaths by the total number of patients with 30-day complications and multiplying that number by 100 to obtain a percentage. In this study, the complications selected were superficial wound infection, deep infection, organ space infection, wound dehiscence, pneumonia, prolonged intubation, pulmonary embolism, acute renal failure, urinary tract infection, stroke, cardiac arrest, myocardial infarction, bleeding requiring transfusion, deep vein thrombosis, sepsis, and septic shock.<sup>17</sup> All statistical analyses were performed with SAS 9.4 (SAS Institute, Cary, NC).

The American College of Surgeons National Surgical Quality Improvement Program and the hospitals participating in the ACS NSQIP are the source of the data used herein; they have not verified and are not responsible for the statistical validity of the data analysis or the conclusions derived by the authors.

## Results

12,602 patients aged 70 years and older who underwent an

emergent (797) or elective (20805) inguinal hernia repair were identified (Table 1). Higher percentages of males underwent elective surgery compared to emergency repair (87.6% vs 70.8%,  $P < 0.0001$ ). Although more male patients underwent both types of hernia repair surgery (87.0% vs 13.0%), the percentage of female patients increases significantly for emergency repair compared to elective (29.2% vs 12.4%,  $P < 0.0001$ , Table 1).

In elderly patients, a significantly higher incidence of comorbidities was seen for emergent than elective cases, COPD (11.3% vs 6.2%,  $P < 0.0001$ ), ventilated (0.3% vs 0.01%,  $P < 0.0001$ ), ascites (0.6% vs 0.1%,  $P = 0.0009$ ), CHF (4.4% vs 1.0%,  $P < 0.0001$ ), open wound/wound infection (1.4% vs 0.3%,  $P < 0.0001$ ), a preoperative weight loss (1.8% vs 0.4%,  $P < 0.0001$ ) and blood disorder (11.9% vs 4.3%,  $P < 0.0001$ , Table 2).

While the overall rates of complications were low in elderly patients, they were more common among emergent cases. These include superficial surgical site infection (0.6% vs 0.2%,  $P = 0.0178$ ), pneumonia (2.1% vs 0.3%,  $P < 0.0001$ ), intubation (0.9% vs 0.1%,  $P < 0.0001$ ), pulmonary embolism (0.4% vs 0.1%,  $P < 0.0035$ ), ventilation for greater than 48 h (0.9% vs 0.04%,  $P < 0.0001$ ), acute renal failure (0.5% vs 0.03%,  $P < 0.0001$ ), urinary tract infection (1.9% vs 0.7%,  $P = 0.0001$ ), cardiac arrest (0.8% vs 0.1%,  $P < 0.0001$ ), myocardial infarction (0.6% vs 0.2%,  $P = 0.0204$ ), bleeding after transfusion (1.1% vs 0.2%,  $P < 0.0001$ ), deep vein thrombosis (1.1% vs 0.1%,  $P < 0.0001$ ), septic shock (0.3% vs 0.1%,  $P = 0.0171$ ), long stay (0.3% vs 0.01%,  $P < 0.0001$ ), reoperation-related (1.8% vs 0.6%,  $P < 0.0001$ ) and readmission (5.4% vs 1.8%,  $P < 0.0001$ , Table 3).

For patients aged 70 years and older, a number of comorbidities were associated with an increasing likelihood of loss of independence: hypertension (OR 1.665, CI 0.928–2.986), dialysis (OR 3.334, CI 0.804–13.816), cancer (OR 4.692, CI 0.973–22.63), wound disruption (OR 6.657, CI 1.637–27.078), preoperative weight loss (OR 4.187, CI 0.974–17.989), bleeding disorder (OR 2.247, CI 1.131–4.464), and preoperative packed red blood cell transfusion (OR 5.418, CI 1.056–27.808). Patients who underwent an elective open or laparoscopic repair were less likely to experience loss of independence (OR 0.061, CI 0.035–0.106) and (OR 0.052, CI 0.024–0.113), respectively (Table 4) after multivariate analysis.

For patients aged 70 years and older, a number of comorbidities were also associated with an increasing likelihood of 30-day mortality: dyspnea (OR 5.522, CI 2.069–14.741), ascites (OR 13.646, CI 1.355–137.46), renal failure (OR 13.913, CI 1.384–139.83), and cancer (OR 15.642, CI 3.204–76.375). Patients who underwent an elective open or laparoscopic repair were less likely to experience mortality (OR 0.07, CI 0.026–0.185) and (OR 0.059, CI 0.015–0.229), respectively (Table 4).

Moreover, emergent cases were more likely to experience loss of independence (8.0% vs 0.5%,  $P < 0.0001$ ), failure to rescue (1.3% vs 0.01%,  $P < 0.0001$ ), mortality (1.4% vs 0.02%,  $P < 0.0001$ , Table 3). Finally, a number of demographic factors and comorbidities were associated with an increasing likelihood of undergoing emergency hernia repair: female gender (OR 0.34, CI 0.29–0.4), black race (OR 1.331, CI 1.012–1.75), Hispanic (OR 1.513, CI 1.12–2.044), COPD (OR 1.637, CI 1.287–2.084), CHF (OR 3.354, CI 2.273–4.951), open wound/wound infection (OR 4.45, CI 2.179–9.089), preoperative weight loss (OR 3.42, CI 1.85–6.323), and bleeding disorder (OR 2.836, CI 2.247–3.579).

## Discussion

Given the rapidly aging population, it is projected that by the year 2035, people who are 65 years and older will outnumber those who are 18 years and younger.<sup>5</sup> A study that examined the rates of emergent abdominal hernia repair between the years of 2001 and

**Table 1**  
Demographics for patients over the age of 70 undergoing laparoscopic and open inguinal hernia repair by emergency of procedure.

| Demographics    | Total (n = 21602) | Emergent (n = 797) | Elective (n = 20805) | P-value |
|-----------------|-------------------|--------------------|----------------------|---------|
| BMI 35-39       | 355 (1.6%)        | 17 (2.1%)          | 338 (1.6%)           | 0.3     |
| BMI 40-49       | 97 (0.5%)         | 6 (0.8%)           | 91 (0.4%)            | 0.2     |
| BMI ≥ 50        | 33 (0.2%)         | 1 (0.1%)           | 32 (0.2%)            | 0.8     |
| Male            | 18785 (87.0%)     | 564 (70.8%)        | 18221 (87.6%)        | <.0001  |
| Female          | 2817 (13.0%)      | 233 (29.2%)        | 2584 (12.4%)         | <.0001  |
| Black           | 1234 (5.7%)       | 62 (7.8%)          | 1172 (5.6%)          | 0.01    |
| Native American | 56 (0.3%)         | 2 (0.3%)           | 54 (0.3%)            | 0.96    |
| White           | 16661 (77.1%)     | 605 (75.9%)        | 16056 (77.2%)        | 0.4     |
| Hispanic        | 904 (4.2%)        | 50 (6.3%)          | 854 (4.1%)           | 0.0027  |
| Smoker          | 1670 (7.7%)       | 77 (9.7%)          | 1593 (7.7%)          | 0.04    |
| Asian           | 629 (2.9%)        | 20 (2.5%)          | 609 (2.9%)           | 0.5     |
| Pacific         | 39 (0.2%)         | 39 (0.2%)          | 0 (0%)               | 0.2     |

BMI = body mass index in kg/m<sup>2</sup>.

**Table 2**  
Comorbidities of patients over the age of 70 undergoing laparoscopic and open inguinal hernia repair.

| Comorbidities                          | Total (n = 21602) | Emergent (n = 797) | Elective (n = 20805) | P-value |
|--|-------------------|--------------------|----------------------|---------|
| Dyspnea                                | 1355 (6.3%)       | 59 (7.4%)          | 1296 (6.2%)          | 0.2     |
| HTN                                    | 13685 (63.4%)     | 500 (62.7%)        | 13185 (63.4%)        | 0.7     |
| Diabetes                               | 2840 (13.2%)      | 110 (13.8%)        | 2730 (13.1%)         | 0.6     |
| COPD                                   | 1369 (6.3%)       | 90 (11.3%)         | 1279 (6.2%)          | <.0001  |
| Ventilated                             | 5 (0.02%)         | 2 (0.3%)           | 3 (0.01%)            | <.0001  |
| Ascites                                | 35 (0.2%)         | 5 (0.6%)           | 30 (0.1%)            | 0.0009  |
| CHF                                    | 242 (1.1%)        | 35 (4.4%)          | 207 (1.0%)           | <.0001  |
| Dialysis                               | 202 (0.9%)        | 11 (1.4%)          | 191 (0.9%)           | 0.2     |
| Cancer                                 | 135 (0.6%)        | 11 (1.4%)          | 124 (0.6%)           | 0.0058  |
| Open Wound (with or without infection) | 53 (0.3%)         | 11 (1.4%)          | 42 (0.2%)            | <.0001  |
| Steroid                                | 612 (2.8%)        | 31 (3.9%)          | 581 (2.8%)           | 0.1     |
| Preoperative weight loss               | 87 (0.4%)         | 14 (1.8%)          | 73 (0.4%)            | <.0001  |
| Bleeding Disorder                      | 996 (4.6%)        | 95 (11.9%)         | 901 (4.3%)           | <.0001  |
| Preop RBC                              | 17 (0.1%)         | 11 (1.4%)          | 6 (0.03%)            | <.0001  |

HTN = hypertension requiring medication, COPD = history of chronic obstructive Pulmonary disease, Ventilated = ventilator dependent, CHF = history of congestive heart failure in 30 days before surgery, Dialysis = currently requiring or on dialysis, Steroid = steroid use for chronic condition, Preoperative weight loss = >10% loss body weight in last 6 months, Preop RBC = Preop Transfusion of ≥1 unit of whole/packed RBCs in 72 h prior to surgery.

**Table 3**  
Postoperative complications of patients over the age of 70 undergoing laparoscopic and open inguinal hernia repair.

| Complication                         | Total (n = 21602) | Emergent (n = 797) | Elective (n = 20805) | P-value |
|--------------------------------------|-------------------|--------------------|----------------------|---------|
| FTR                                  | 13 (0.1%)         | 10 (1.3%)          | 3 (0.01%)            | <.0001  |
| Mortality                            | 16 (0.1%)         | 11 (1.4%)          | 5 (0.02%)            | <.0001  |
| LOI                                  | 170 (0.8%)        | 64 (8.03%)         | 106 (0.5%)           | <.0001  |
| Superficial wound infection          | 50 (0.2%)         | 5 (0.6%)           | 45 (0.2%)            | 0.02    |
| Deep infection                       | 11 (0.1%)         | 1 (0.1%)           | 10 (0.1%)            | 0.3     |
| Organ Space                          | 8 (0.04%)         | 5 (0.02%)          | 3 (0.4%)             | <.0001  |
| Wound Disruption                     | 8 (0.04%)         | 5 (0.02%)          | 3 (0.4%)             | <.0001  |
| Pneumonia                            | 68 (0.3%)         | 17 (2.1%)          | 51 (0.3%)            | <.0001  |
| Intubation                           | 27 (0.1%)         | 7 (0.9%)           | 20 (0.1%)            | <.0001  |
| Pulmonary embolism                   | 18 (0.1%)         | 3 (0.4%)           | 15 (0.1%)            | 0.0035  |
| Postoperative mechanical ventilation | 15 (0.1%)         | 7 (0.9%)           | 8 (0.04%)            | <.0001  |
| Acute renal failure                  | 11 (0.1%)         | 4 (0.5%)           | 7 (0.03%)            | <.0001  |
| Renal Insuf                          | 29 (0.1%)         | 27 (0.1%)          | 2 (0.3%)             | 0.4     |
| UTI                                  | 161 (0.8%)        | 15 (1.9%)          | 146 (0.7%)           | 0.0001  |
| Stroke                               | 16 (0.1%)         | 2 (0.3%)           | 14 (0.1%)            | 0.1     |
| Cardiac Arrest requiring CPR         | 17 (0.1%)         | 6 (0.8%)           | 11 (0.1%)            | <.0001  |
| MI                                   | 51 (0.2%)         | 5 (0.6%)           | 46 (0.2%)            | 0.02    |
| Bleeding after transfusion           | 40 (0.2%)         | 9 (1.1%)           | 31 (0.2%)            | <.0001  |
| DVT                                  | 31 (0.1%)         | 9 (1.1%)           | 22 (0.1%)            | <.0001  |
| Sepsis                               | 45 (0.2%)         | 37 (0.2%)          | 8 (1.0%)             | <.0001  |
| Septic shock                         | 12 (0.1%)         | 2 (0.3%)           | 10 (0.05%)           | 0.02    |
| Still in Hospital > 30 Days          | 5 (0.02%)         | 2 (0.3%)           | 3 (0.01%)            | <.0001  |
| Unplanned Reoperation                | 129 (0.6%)        | 14 (1.8%)          | 115 (0.6%)           | <.0001  |
| Readmission                          | 415 (1.9%)        | 43 (5.4%)          | 372 (1.8%)           | <.0001  |

FTR = failure to rescue, LOI = loss of independence, Superinfect = Occurrences superficial incisional surgical site infection, Renal insuf = occurrences progressive renal insufficiency, UTI= Urinary Tract Infection, MI = Myocardial Infarction, Bleeding after transfusion = Intraoperative or postoperative (within the first 72 h) packed red blood cell transfusion, DVT = deep vein thrombosis/thrombophlebitis.

**Table 4**  
Logistic backward analysis for patients over the age of 70 undergoing laparoscopic and open inguinal hernia repair.

| Variables                   | Odds Ratio | 95% Wald          |        |
|-----------------------------|------------|-------------------|--------|
|                             |            | Confidence Limits |        |
| <b>Loss of Independence</b> |            |                   |        |
| Elective Open               | 0.061      | 0.035             | 0.106  |
| Elective Laparoscopic       | 0.052      | 0.024             | 0.113  |
| HTN                         | 1.665      | 0.928             | 2.986  |
| Dialysis                    | 3.334      | 0.804             | 13.816 |
| Cancer                      | 4.692      | 0.973             | 22.63  |
| Wound Disruption            | 6.657      | 1.637             | 27.078 |
| Preoperative Weight Loss    | 4.187      | 0.974             | 17.989 |
| Bleeding Disorder           | 2.247      | 1.131             | 4.464  |
| Preop Blood Transfusion     | 5.418      | 1.056             | 27.808 |
| <b>Mortality</b>            |            |                   |        |
| Elective Open               | 0.07       | 0.026             | 0.185  |
| Elective Laparoscopic       | 0.059      | 0.015             | 0.229  |
| Dyspnea                     | 5.522      | 2.069             | 14.741 |
| Ascites                     | 13.646     | 1.355             | 137.46 |
| Renal Failure               | 13.913     | 1.384             | 139.83 |
| Cancer                      | 15.642     | 3.204             | 76.375 |

Preoperative Weight Loss = greater than 10% loss in body weight in last 6 months, Preop Blood Transfusion = preoperative transfusion of greater than or equal to 1 unit of packed red blood cells in 72 h prior to surgery.

2010, saw that the increasing rates were highest among the elderly.<sup>18</sup> There have been concerns about performing elective hernia repair in the elderly population due to older age and their coexisting illnesses. These comorbidities were found to be associated with higher risk of complications: COPD, coronary artery disease, low preoperative serum albumin, diabetes and dementia.<sup>19–22</sup> In general, prior publications have indicated that inguinal hernia repair is safe in the elderly population when performed in an elective setting.<sup>22–25</sup> In fact, studies have concluded that there is an increased risk of mortality and severe complications when repair is performed emergently.<sup>20,22,26–28</sup>

There has been previous support for watchful waiting of inguinal hernia in elderly patients about whether it is necessary to repair all inguinal hernias. The decision to repair an inguinal hernia depends primarily on gender and patient symptoms; a male patient with an asymptomatic inguinal hernia may be managed expectantly. This is supported by a low probability that a hernia complication will occur. The lifetime risk of a hernia strangulation occurring in a 72-year-old, for instance, has been calculated to be 1 in 22.<sup>7,3</sup> A randomized control trial by Fitzgibbons also evaluated watchful waiting and has determined its acceptability in patients based upon complaints of hernia-related pain.<sup>14</sup>

The literature supports watchful waiting of low-risk inguinal hernias.<sup>8–11</sup> One of the deterrents to aggressive management of all inguinal hernias is the risk of postoperative complications, especially long-term chronic pain which is reported to be as high as 6–8%. Chronic pain is the most studied postoperative complication that provides insight into the quality of life of the patient after surgery.<sup>30</sup> This pain can disrupt daily activities such as work, sleep, mood, walking and relationships with other people.<sup>31</sup>

While complications after elective inguinal hernia occur, complications after emergency inguinal hernia repair are more severe and debilitating. This study shows increased length of stay, readmission, and failure to rescue after emergency surgery. This is consistent with a previous study by Wu et al. demonstrated worsening complications after emergency inguinal hernia repair in elderly patients.<sup>22</sup> This study reveals an increased loss of independence in elderly patients who undergo emergency inguinal hernia repair versus elective repair. After emergency inguinal hernia repair, the loss of independence rates in elderly patients climbs significantly.

Given the significant debility that occurs after emergency

surgery in elderly patients, identifying patients at high risk for emergency hernia repair is important. In the present study, a greater proportion of women underwent emergency inguinal hernia repair than men. This is consistent with other reports and current guidelines discourage watchful waiting in females since these patients are at increased risk of emergency surgery.<sup>32,33</sup> Additionally, a greater proportion of patients with COPD, CHF, and bleeding disorders underwent emergency surgery in this study. Further assessment is required to delineate which of these medical comorbidities are truly prohibitive for elective surgery and which might simply require more optimization prior to repair.

There are limitations to studies utilizing large databases such as ACS NSQIP; these tend to be subject to sampling error as well as errors with CPT coding. The inability to identify preoperative factors such as patient frailty or even the extent of the disease (e.g. small bowel obstruction versus necrotic bowel) is also a limitation. Furthermore, this dataset does not allow the identification of postoperative clinical markers such as laboratory results or hemodynamic status. It is important to note that watchful waiting literature suggests that surgery is advised if inguinal hernias are symptomatic. However, one cannot assess if a patient is symptomatic prior to surgery, using the NSQIP database. Finally, the NSQIP database, which contains only surgical patients, cannot be used to evaluate patients that underwent watchful waiting. This would be a valuable control group.

**Conclusions**

There is significant debility that occurs following emergency inguinal hernia repair in elderly patients. This may suggest a more proactive approach in patients older than 70 years with elective inguinal hernia surgery in order to reduce emergencies and loss of independence.

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