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Inpatient outcomes after Elective versus Non-Elective Ventral Hernia Repair

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Abstract

Background—Patients who present emergently with hernia related concerns may experience increased morbidity with repair when compared to those repaired electively. We sought to characterize the outcomes of patients who undergo elective and non-elective VH repair using a large population-based data set.

Materials and Methods—The Nationwide Inpatient Sample (NIS) was queried for primary ICD-9 codes associated with VH repair (years 2008–2011). Outcomes were in-hospital mortality and the occurrence of a pre-identified complication. Multivariable analysis was performed to determine the risk factors for complications and mortality following both elective and non-elective VH repair.

Results—We identified 74,151 VH repairs performed during the study interval. Of these procedures, 67.3% were elective and 21.6% were performed laparoscopically. Non-elective repair was associated with a significantly higher rate of morbidity (22.5% vs. 18.8%, $p<0.01$) and mortality (1.8% vs. 0.52, $p<0.01$) than elective repair. Elective repairs were more likely to occur in younger patients, Caucasians, and were more likely to be performed laparoscopically. Logistic modeling revealed that female gender, Caucasian race, elective case status, and laparoscopic approach were independently associated with a lower probability of complications and mortality. Minority status and Medicaid payer status ware associated with increased probability of non-elective admission.

Conclusions—Patients undergoing elective ventral hernia repair in the United States tend to be younger, Caucasian and more likely to have a laparoscopic repair. Non-elective VH is associated with a substantial increase in morbidity and mortality. We recommend that patients consider elective repair of ventral hernias due to the increased morbidity and mortality associated with non-elective repair.

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Keywords

Ventral hernia; *NIS*; *Elective*; *Non-elective*

Introduction

Ventral hernia (VH) repair remains one of the most common general surgery procedures. In a survey of general and plastic surgeons it was documented that the majority of surgeons do not routinely repair abdominal wall hernias in asymptomatic patients on an elective basis [1]. Patients who present with acute complaints related to their hernia may experience an increase in morbidity compared to those who present electively. Patients who undergo emergent surgery may also be different than those who opt to undergo or who are offered elective surgery [2]. We sought to characterize the outcomes of patients who undergo elective and non-elective VH repair using a large population-based data set. We hypothesized that emergent VH repair would be associated with increased morbidity and mortality rates, and that patients who undergo elective repair were different from those undergoing emergent surgery.

Materials and Methods

A retrospective population-analysis was performed using the Nationwide Inpatient Sample (NIS) for the years 2008–2011. The NIS is the largest all-payer inpatient care database in the United States, containing data on more than seven million hospital stays from approximately 1,000 hospitals participating in the Healthcare Cost and Utilization Project (HCUP) and maintained by the Agency for Healthcare Research and Quality (AHRQ). This represents approximately 20% of stratified samples of U.S. hospitals in 49 states. The large sample size is ideal for developing national and regional estimates and enables analyses on rare conditions, uncommon treatments, and special populations [3]. As the database is de-identified, the study was exempt from the institutional review board approval process.

Patients were identified for this study according to the International Classification of Diseases, Ninth Revision (ICD-9) procedure and diagnosis codes. Elective ventral hernia repairs were coded as elective. Urgent and emergent ventral hernia repairs were coded as non-elective. The ICD-9 codes for ventral hernia repair included those for open and laparoscopic repairs and are listed in table 1. Patients who underwent a primary procedure other than ventral hernia repair were excluded as well as those who underwent any resection of the gastrointestinal tract.

Study variables extracted for analysis included age, race, sex, a weighted Charlson Comorbidity Index score as a marker of their co-morbidities, operative intervention (laparoscopic versus open procedure type), as well as in-hospital morbidity and mortality. The Charlson Comorbidity Index (CCI) predicts the ten-year mortality for a patient based on 15 conditions (table 2) [4]. Each condition is assigned a score of 1, 2, 3, or 6 depending on risk of dying for each condition. A summation of all scores is calculated to predict mortality. Adverse outcomes were selected on likely association with time to surgery (table 1).

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Continuous data was reported as mean values, while categorical variables were reported as percentages. Bivariate analysis of categorical data was performed using Chi-Square tests, and for continuous data, two-tailed *t*-tests were used. Multivariable analysis was performed using multiple logistic regression models, adjusting for age, sex, elective versus emergent status, race, pretreatment comorbidities and operative approach, to identify risk factors for postoperative morbidity and mortality. A p-value <0.05 was considered to be statistically significant. Statistical analysis was conducted using SAS 9.2 (SAS Institute, Cary, NC). All analyses were adjusted for the complex survey design of NIS, using the SurveyFreq and SurveyLogistic procedures for the analyses.

Results

A total of 74,151 patients undergoing ventral hernia repair in the study interval were identified. Of these procedures, 67.3% were elective and 21.6% were performed laparoscopically. The overall complication rate was 20.0% and overall mortality was 0.95%. Non-elective repair was associated with a significantly higher rate of complications (22.5% vs. 18.8%, p<0.01) and mortality (1.8% vs. 0.52%, p<0.01) than elective repair (table 3). In general, patients undergoing elective repair were younger, Caucasian, and more likely to have laparoscopic repair. Patients undergoing non-elective repair were more likely to be female, have a higher weighted CCI Score, and increased rates of complication and mortality (table 3).

On multivariable analysis of complications, female gender, Caucasian, elective procedures, and laparoscopic technique were independently associated with lower odds of complications (table 4). For each additional year of age, the odds of having a complication increased by 1.2% (p<0.01). For every one point increase in the CCI, the odds of having a complication increased by 8.6% (p<0.01). On multivariable analysis for mortality, younger age, female gender, Caucasian, lower CCI, elective procedures, and laparoscopic technique were independently associated with lower risk of death (table 5). For each additional year of age, the risk of mortality increased by 5.7%. For every one-point increase in the CCI, the odds of mortality increase 26.9%.

On multivariable analysis for socio-demographics, racial minority status was independently associated with non-elective admission (table 6). Non-elective admission rate was greatest among African Americans (69.8%), Hispanics (37.6%), and Other Ethnic Category (60.4%) compared to Caucasians. Private payer status was independently associated with lower risk of non-elective admission (table 6). No significant difference was detected for income level.

Discussion

This study is a large, retrospective analysis of the Nationwide Inpatient Sample with regards to ventral hernia repairs performed between the years 2008–2011. Through this analysis we were able to demonstrate our primary and secondary objectives. Firstly, that patients who undergo elective repair are different from those who undergo non-elective repair—namely, that they are younger, Caucasian and more likely to undergo a laparoscopic repair. Our secondary objective sought to describe the difference in outcomes between elective and non-

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elective repair. We demonstrated that morbidity and mortality were improved in elective versus non-elective repair. Above and beyond these endpoints, we found that despite the majority of hernia repairs in the United States being performed electively, the laparoscopic approach is utilized infrequently. We demonstrated that female gender, Caucasian race, elective case status and laparoscopic repair were independently associated with lower complications and mortality. Minority status and Medicaid payer status were associated with an increased probability of non-elective repair.

We have demonstrated that the outcome of ventral hernia repair in a non-elective setting includes an increase in morbidity (22%) and mortality (1.8%) compared to the elective setting (18%, 0.55%, $p < 0.01$). This finding is in concordance with studies evaluating non-elective repair of paraesophageal hernias, in that patients undergoing elective, laparoscopic hernia repair have improved morbidity and mortality [5]. Several other studies have investigated the impact of non-elective abdominal wall hernia repair and have demonstrated similar increases in morbidity and mortality [2]. Altom et al found a more than two-fold incidence of post-operative complications in emergent versus elective ventral hernia repairs, an increased post-operative length of stay (7 days versus 4 days) and increased likelihood of a primary suture repair (49% versus 31%) [2].

Our study validates previous studies that examined the utilization of laparoscopic repair for ventral hernia repair. We demonstrated that although 67% of ventral hernias were repaired electively, only 22% were done so laparoscopically. These values are in concordance with the study by Funk et al which reviewed elective repair of incisional, ventral or epigastric hernias, and found only 20% were performed laparoscopically [6]. These values suggest an underutilization of the laparoscopic hernia repair despite published data that suggests improved short term post-operative outcomes, decreased wound complications and infections requiring mesh removal, shorter hospital length of stay, and decreased hospital costs associated with the laparoscopic repair [7–9]. Colavita et al reported similar outcomes in an analysis of prosthetic mesh using the Nationwide Inpatient Sample [10, 11]. In this series, only 27% of ventral hernia repairs were performed laparoscopically.

Our analysis indicates a statistically significant difference in elective versus non-elective admission type based on race. We found that a racial minority status was independently associated with a non-elective admission. African-Americans and Hispanics were more likely to have a non-elective admission compared to Caucasians (69.8% and 37.6% respectively). We found that non-private payer status was independently associated with a non-elective admission. Our study parallels the findings of Bowman et al who investigated racial disparities in the type of presentation for ventral hernia repairs. They found that African-Americans were more likely to have acute and complicated presentations requiring non-elective repair than Caucasian patients (11% versus 4%) [12]. This difference persisted despite controlling for socioeconomic or payer status. African-Americans also had increased incidence of 30-day readmissions compared to Caucasian patients when controlling for other factors.

When payer status was evaluated independently in this analysis, it was found that patients with Medicaid status were more likely to have acute presentations, including incarceration

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or strangulation, than privately insured patients. These patients likewise have longer hospital stays [12]. Many studies have investigated the contribution of financial and socioeconomic factors into health disparities, and suggested that poor access to care, financial impingements or insurance status may be contributing [13]. African-Americans, however, were more likely to present acutely despite similar payment types. A good example of this is demonstrated in a retrospective cohort study performed by Altom, et al, between the years 1998–2002. In this study examining emergent ventral hernia repairs in 16 Veteran's Affairs Medical Centers, they demonstrated that patient's undergoing emergent repair were more likely to be African-American (20% versus 8.6%, p=0.02) [2]. This finding was of particular interest as previous studies have suggested that racial disparities in care may be attributed to access to care or socioeconomic status whereas patients at the Veteran's Affairs system arguable have similar access to care. The authors discuss alternative rationales for this disparity are likely multifactorial but may relate to trust and skepticism, in addition to communication issues [2]. Our findings are similar to those of previous studies that suggest payer type or socioeconomic status alone does not explain the racial disparity in the presentation or management of ventral hernias [2, 12]. This finding may point more towards a detriment in perceptions of health care that delay the presentation in these patients.

We found no significant difference in income level associated with an elective versus non-elective admission. Colavita, et al, analyzed income level by zip code as well and noted a trend towards increased use of laparoscopic repairs in zip codes of increased median income, although this trend was not statistically significant. Our analysis did not include population-based variables; however in the analysis by Colavita, patients were more likely to receive laparoscopic procedures in metropolitan areas with populations 50,000–249,000 [11]. When analyzed by payer status, those patients undergoing a laparoscopic repair were more likely to have private payer status. In previous studies looking at the outcome of primary payer status on major surgical operations, LePar, et al, found that patients' post-operative mortality was independently associated with their payer status; privately insured patients fared better with a mortality of 1.2% than those with Medicaid (4.4%), Medicare (3.7%) or uninsured (3.2%) [14]. The authors of this study acknowledge that the etiology is likely multifactorial; however, it may be in part to patients with Medicare or private insurance having greater access to specialist, and are therefore more likely to have an elective procedure.

The increase in morbidity and mortality associated with ventral hernia repair with increasing age and CCI is in line with previously reported data [2, 10]. We found that with each year increase in age, patients were at 1.2% increased risk of a complication. Using the CCI score we found that patients were at 8.6% increased risk of a complication with each increase in 1 point on the scale. Multiple studies have demonstrated that with increasing CCI scores there is an increased association with open ventral hernia repair and increased incidence of a non-elective repair [6, 11]. Altom, et al, pointed out in their cohort that the mortalities suffered after ventral hernia repair were in patients with previously diagnosed comorbid disease, and that post-operative deaths were related to complications of these diagnoses [2].

The limitations to our study include those inherent to use of the Nationwide Inpatient Sample (NIS) as a database. The NIS database underestimates the 30-day complication and

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mortality rates for all procedures, as death and complications that occur after discharge are not included within the dataset. Other authors such as Altom, et al, have investigated the implications of emergent incisional hernia repair, reporting post-operative complications and mortality within a 30-day post-operative period—both variables which are not feasible using the Nationwide Inpatient Sample bdpf0060 [2]. This limitation may suggest an advantage of using a disease specific nationwide prospective database such as the Americas Hernia Society Quality Collaborative [15].

We are also limited by the coding capabilities of the dataset and are therefore are unable to determine the exact nature of patient's presentation for surgery, degree of symptoms or duration of symptoms. We know from previous studies regarding inguinal hernias that the majority will enlarge over time and progress to the point where surgical intervention is required when a watchful waiting method is implored [16, 17]. The natural history of abdominal wall hernias, however, is largely unknown. Utilizing a watchful waiting approach to VH incites the potential for progression towards a larger, symptomatic hernia with risks of a presentation necessitating a non-elective repair. Despite these risks, in our study we are unable to determine what comorbidities or patient related qualities had factored into previous management decisions prior to their admission. In a survey targeting the motives of surgeons regarding management of large ventral hernias, it was found that the top contraindications for repair included a BMI >35, an ASA class III or IV, presence of an entero-cutaneous fistula, current smokers or steroid dependence [1]. Without this pre-admission data we are unable to determine if patients who presented for a non-elective repair did so out of failure of non-operative management or had never sought treatment before. While we are limited by the lack of pre-admission data, these limitations are offset by the value that the NIS offers as far as a large patient sample and a cross-section of patients thought-out the United States.

In our study we demonstrated that patients undergoing elective ventral hernia repair in the United States tend to be younger, Caucasian and more likely to have a laparoscopic repair. The morbidity and mortality rates were higher in emergent cases. Multivariable analysis reveals that younger patients, undergoing elective, laparoscopic ventral hernia repair had the best outcomes. We independently demonstrated that male patients, with increased Charlson Comorbidity Indices, having non-elective surgery, had the highest morbidity and mortality. This study also points out the ongoing racial and socioeconomic disparity associated with ventral hernia repair. This data is consistent with previous data suggesting a multifactorial etiology other than health care access, and will need further studies to determine potential contributing factors.

Considering the above, we recommend that this data be used to counsel patients on the management decisions regarding their ventral hernia. The demonstrated increased morbidity and mortality associated with non-elective repair may be used for further studies regarding the management of ventral hernia repairs, as well as provide useful data with which to provide for informed decision making in the clinical setting.

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Table 1

ICD-9-CM procedure and diagnosis codes

ICD-9-CM Code	Description
Inclusion	
Laparoscopic VHR	53.62, 53.63
Open VHR	53.61, 53.69
Exclusion	
GI tract Resection	42.4x, 43.5x–43.9x, 44.3x, 45.5x–45.8x, 48.5x–48.6x, 50.3x–50.5x, 52.5x, 52.6, 52.7, 52.8x
Complications	
GI	
997.4	Digestive system complications not elsewhere classified
863	Injury to gastrointestinal tract
Wound	
998.83	Non-healing surgical would
43.61	Re-closure of postoperative disruption of abdominal wall
998.3	Disruption of wound
998.6	Persistent post-operative fistula
998.12	Hematoma complicating a procedure
998.13	Seroma complicating a procedure
Procedural	
998.9	Unspecified complication of procedure not elsewhere classified
998.89	Other specified complications of procedures not elsewhere classified
998.2	Accidental puncture/laceration complicating procedure
998.4	Foreign Body left during a procedure
998.11	Hemorrhage complicating a procedure
868	Injury to other intra-abdominal organs
Infectious	
998.5	Post-operative infection not elsewhere classified
Urinary	
997.5	Urinary complications not elsewhere classified
Pulmonary	
512.1	Iatrogenic pneumothorax
518.4	Acute edema of the lung, unspecified
518.5	Pulmonary insufficiency following trauma and surgery
997.3x	Respiratory complications not otherwise specified
Cardiac	
415.11	Pulmonary embolism and infarction
997.02	Iatrogenic cerebrovascular infarction or hemorrhage
997.1	Cardiac complications not otherwise specified
997.2	Peripheral vascular complications

ICD-9-CM Code	Description
997.79	Vascular complications of other vessels
Systemic	
998	Post-operative shock not elsewhere classified

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Table 2

Charlson Comorbidity Index (CCI) conditions and associated ICD-9CM Codes

Condition	ICD-9-CM Code
Myocardial infarction	410–410.9
Congestive heart Failure	428–428.9
Peripheral Vascular Disease	433.9, 441–441.9, 785.4, V43.4
Cerebrovascular Disease	430–438
Dementia	290–290.9
Chronic Pulmonary Disease	490–496, 500–505, 506.4
Rheumatologic Disease	710.0, 710.1, 710.4, 714.0–714.2, 714.81, 725
Peptic Ulcer Disease	531–534.9
Mild Liver Disease	571.2, 571.5, 571.6, 571.4–571.49
Diabetes	250–250.3, 250.7
Diabetes with Chronic Complications	250.4–250.6
Hemiplegia or Paraplegia	344.1, 342–342.9
Renal Disease	582–582.9, 583–583.7, 585, 586, 588–588.9
Moderate or Severe Liver Disease	572.2–572.8
AIDS	042–044.9

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Table 3

Elective versus Non-elective ventral hernia repair

Variable	Elective (n=49,980)	Non-elective (n=24,171)	*p* value
Age (years)	58.4	58.9	<0.01
Sex (% female)	61.3%	65.8%	<0.01
Race (% Caucasian)	81.8%	73.1%	<0.01
Laparoscopic (%)	23.3%	18.2%	<0.01
Weighted CCI score[a]	0.87	1.03	<0.01
Number of Complications (mean)	0.32	0.39	<0.01
Complication (%)	18.8%	22.5%	<0.01
Mortality	0.52%	1.8%	<0.01

[a]CCI=Weighted Charlson Comorbidity Score

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Table 4

Odds ratio for probability of complication

Variable	Odds Ratio	95% CI	*p* value
Age	1.012	1.011 – 1.014	<0.01
Female	0.726	0.697 – 0.757	<0.01
Caucasian	0.994	0.938 – 1.054	0.84
CCI[a]	1.086	1.070 – 1.102	<0.01
Elective Surgery	0.840	0.797 – 0.885	<0.01
Laparoscopic Surgery	0.640	0.599 – 0.685	<0.01

[a]CCI=Weighted Charlson Comorbidity Score

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Table 5

Odds ratio for probability of mortality

Variable	Odds Ratio	95% CI	*p* value
Age	1.057	1.049 – 1.064	<0.01
Female	0.654	0.561 – 0.762	<0.01
Caucasian	0.994	0.753 – 1.183	0.61
CCI	1.269	1.229 – 1.309	<0.01
Elective Surgery	0.325	0.273 – 0.386	<0.01
Laparoscopic Surgery	0.566	0.438 – 0.730	<0.01

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Table 6

Odds ratio for probability of Non-elective repair based on socio-demographics

Variable	Odds Ratio	95% CI	*p* value
Ethnicity			
Caucasian	1.00	-	<0.01
Black	1.698	1.544 – 1.868	
Hispanic	1.376	1.183 – 1.599	
Other	1.604	1.258 – 2.044	
Income			
$1 – 38,999	1.00	-	0.20
$39,000 – 47,999	0.969	0.891 – 1.053	
$48,000 – 62,999	0.940	0.860 – 1.027	
$63,000+	1.036	0.904 – 1.187	
Insurance			
Medicare	1.00	-	<0.01
Medicaid	1.138	1.049 – 1.234	
No Charge	1.443	0.869 – 2.396	
Other	0.878	0.766 – 1.007	
Private	0.804	0.763 – 0.846	
Self-pay	2.107	1.718 – 2.585	