

Infection and Recurrence Rates in Rural Inguinal Hernia Repair

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ABSTRACT

Introduction. Inguinal hernia repair (IHR) is a common procedure performed by general surgeons in rural community hospitals. Infection and recurrence rates for three types of IHR over two years at a rural Kansas hospital were analyzed. Previous research has shown outcomes regarding pain at six weeks were typically no different, and neither were long-term results, between open and laparoscopic techniques. However, there were fewer data showing the outcomes of these three hernia repair approaches in rural settings.

Methods. This was a retrospective, cross-sectional study using data collected from the electronic medical record (EMR) of a small hospital in central Kansas. Data from adult patients who had undergone IHRs over a two-year period (2018-2019) were deidentified and described using frequencies and percentages. This study used multi-variate logistic regression to examine the association of patient, surgeon, and surgical procedure characteristics on the occurrence of post-operative complications.

Results. Of the patients who received IHR, 46 were male and 5 were female. Mean age was 66 years, with a minimum of 34 and maximum ≥ 89 years. There were 14 total post-operative complications; two were superficial infections. There were no recurrences.

Conclusions. The sample size for each procedure type was too small to allow for statistical testing. However, the hospital had no recurrences. Future research should follow-up with this and other rural hospitals and perform a direct comparison of hernia surgery outcomes with those at a larger, more urban hospital, to understand potential differences by hospital size. *Kans J Med* 2023;16:65-68

INTRODUCTION

An inguinal (groin) hernia is a common condition in which tissue or part of the intestine protrudes through a weakened area in the lower abdominal wall.^{1,3} Inguinal hernias can be repaired three ways: open, laparoscopic, and robotic. In an elective repair, a mesh is placed from the inside of the abdomen to strengthen the wall. The most common post-surgical complications of IHR (of any type) include infection, seroma, hematoma, chronic groin pain, recurrence, sexual dysfunction with pain, and in males, ejaculatory disorders, and/or infertility.

The benefits of open repair techniques include decreased cost, shorter operation time, an option to be performed under local anesthesia, and ability to be performed by general surgeons.¹ Conversely, to gain access to the area, a larger incision must be used, thus nerve damage is a more common complication.^{1,4}

When compared to the open repair, the laparoscopic repair has benefits of utilizing smaller (although multiple) incisions to gain access, ability to repair the contralateral side (if found to be bilateral), less post-operative pain and nerve damage,⁵ and faster recovery time for the patient.^{1,3,6,7} However, the operation costs more because it takes longer,

utilizes general anesthesia, and utilizes specialized laparoscopic tools.

There also is a steeper learning curve associated with higher recurrence rates during the time of surgical training.^{1,8,9} While post-operative complications were uncommon, they tended to be more severe when present.^{3,6}

It is still debated whether one of these repairs is superior to the other; however, both have been found to be viable repair options.³ Recurrence rates have been found to be no different between open and laparoscopic repairs, provided a mesh is used.^{1,2} Outcomes regarding pain at six weeks were typically no different, and neither were long-term results.⁹

The study investigated the incidence of infection and recurrence associated with three methods of inguinal hernia repair (IHR) at the only hospital in a rural Kansas county, open plug-and-patch (OPP), open Lichtenstein (OL), and laparoscopic transabdominal pre-peritoneal (TAPP), to understand if there were differences in the rates of infection or rates of hernia recurrence by method.

METHODS

The rural hospital had not participated previously as a research site for surgical outcomes. The robotic method was not available. The EMR was updated in 2014, and exporting data was more challenging than anticipated.

This retrospective, cross-sectional study utilized EMR data on IHRs completed January 1, 2018 through December 31, 2019 at a rural hospital in Kansas. Inclusion criteria included IHRs performed on adult patients during the study period at the selected rural hospital. Exclusion criteria included patient was younger than 18 and emergency procedure (non-elective). Emergent procedures were excluded because a mesh is not placed due to the high risk for harboring infection.¹⁰ Additionally, not placing a mesh had been shown to have higher hernia recurrence rates.

From the patient record, sex, age, insurance status, employment status, previous abdominal surgery, body mass index (BMI) category, smoking status, diabetes, immunocompromised status, and chronic conditions associated with cough or constipation were collected. For privacy purposes, any subject age over 89 was set at 89. The chronic conditions were chosen based on what the surgeons have believed to be linked with increased inguinal hernia risk. From the surgical record, location and type of inguinal hernia, operating surgeon, procedure used (OPP, OL, TAPP), and type of mesh were collected. From the follow-up history, data about post-operative complications were collected, including infection and recurrence.

Statistical Analysis. To achieve the objectives, descriptive statistics were calculated on the variables of interest. Bivariate tests were used to compare groups. Data were analyzed using multivariate logistic regression, with complication as a binary outcome variable (0 for no complication and 1 for a complication). All data were deidentified and analyzed using Stata SE 15. The University of Kansas Medical Center Institutional Review Board approved this study.

RESULTS

Of the 54 eligible charts reviewed, one patient was lost to follow-up. Two patients met exclusion criteria for incarcerated (emergent) surgery. Fifty-one patients' surgical procedures were included for analyses.

There were 46 males and 5 females. The mean age of IHR patients was 66 (SD 13.0), with a range of 34 to 89. Five (9.8%) patients were covered by Medicare, 25 (49.0%) by private insurance, and 19 (37.3%) patients had both Medicare and private insurance. There were two (3.9%) patients with an unknown insurance status. There were 24 (47.0%) patients who were employed full-time at the time of surgery, 21 (41.2%) who were retired, and 6 (11.8%) with an unknown employment status. Further detail is available in Table 1.

Table 1. Patient demographic characteristics.

Demographics	n (%)
Total	51 (100)
Gender	
Male	46 (90.2)
Female	5 (9.8)
Age	
≤ 59	14 (27.5)
≥ 60	37 (72.5)
Insurance Status	
Medicare	5 (9.8)
Private	25 (49.0)
Medicare + Private	19 (37.3)
Unknown	2 (3.9)
Employment	
Full-time	24 (47.0)
Part-time	0 (0)
Retired	21 (41.2)
Unknown	6 (11.8)

Two (3.9%) patients were characterized as underweight by BMI category, 23 (45.1%) as at a healthy weight, 17 (33.3%) as overweight, 6 (11.8%) as obese, and 2 (3.9%) as morbidly obese. One (2%) patient had an unknown BMI. There were 31 (60.8%) never-smokers, 7 (13.7%) with a past history of smoking, 7 (13.7%) current smokers, and 6 (11.8%) with an unknown smoking status. Two (3.9%) patients chewed tobacco. There were four (7.8%) patients with diabetes mellitus and eight (15.7%) who were immunocompromised. Eleven (21.6%) patients had disorders associated with increased abdominal pressure, such as cough or constipation. Nineteen (37.3%) patients had a previous history of abdominal surgery. Patients' risk factors are detailed in Table 2.

Table 2. Patient risk factors.

Body Mass Index Category	n (%)
Below 18.5	2 (3.9)
18.5-24.9	23 (45.1)
25.0-29.9	17 (33.3)
30.0-39.9	6 (11.8)
40.0+	2 (3.9)
Unknown	1 (2.0)
Smoking Status	
Never-smoker	31 (60.8)
Current	7 (13.7)
Past history of smoking	7 (13.7)
Unknown	6 (11.8)
Chewing Tobacco	
Current	2 (3.9)
Past history	0 (0)
Never	49 (96.1)
Diabetic status (Yes)	4 (7.8)
Immunocompromised (Yes)	8 (15.7)
Chronic cough or constipation (Yes)	11 (21.6)
Previous abdominal surgery (Yes)	19 (37.3)

There were 23 (45.1%) inguinal hernias on the right side and 24 (47.1%) on the left side. There were four (7.8%) patients who had bilateral hernia repairs. Fourteen (27.5%) hernias were direct and 37 (72.5%) were indirect. Five (9.8%) hernias were subtyped as sliding. Twelve (23.5%) patients had received previous IHRs, five (9.8%) of these being on the same side. There were 40 (78.4%) open (Lichtenstein), 9 (17.7%) open (Plug and patch), and 2 (3.9%) laparoscopic (TAPP). These data are detailed in Table 3.

Table 3. Hernia characteristics.

Side of Inguinal Hernia Repair (IHR)	n (%)
Right	23 (45.1)
Left	24 (47.1)
Bilateral (Yes)	4 (7.8)
Hernia Type	
Indirect	37 (72.5)
Direct	14 (27.5)
Hernia subtype - Sliding	5 (9.8)
Previous IHR (Yes)	12 (23.5)
Previous IHR on same side (Yes)	5 (9.8)
Surgical Procedure	
Open Lichtenstein	40 (78.4)
Open plug-and-patch	9 (17.7)
Laparoscopic transabdominal pre-peritoneal	2 (3.9)
Surgeon of Procedures	
Surgeon 1	39 (76.5)
Surgeon 2	10 (19.6)
Surgeon 3	2 (3.9)

Seven (13.7%) patients had post-operative complications, some with multiple complications. There was a total of 14 complications, all of which were minor. Two (28.6%) patients developed seromas, two (28.6%) developed hematomas, two (28.6%) had paresthesia at six weeks post-operative, three (42.9%) with groin pain at six weeks post-operative, two (28.6%) with superficial infections, one (14.3%) with urinary incontinence, one (14.3%) with testicular swelling, and one (14.3%) with blood during ejaculation. There were two patients who had a total of six complications. One patient had four complications, while the other had two. During the period of the study, there were no recurrences of inguinal hernia. Of these complications, 11 (78.6%) were performed by Surgeon 1, 2 (14.3%) by Surgeon 2, and 1 (7.1%) by Surgeon 3. However, the rates of complications by surgeon (# of complications over total patients for an individual surgeon) showed a different distribution: 11/39 (28.2%) for Surgeon 1, 2/10 (20.0%) for Surgeon 2, and 1/2 (50.0%) for Surgeon 3. These data are detailed in Table 4. The sample sizes for each procedure and complication type were too small to allow for statistical testing.

Table 4. Post-operative complications at follow-up.

Patients with Complications (n = 7)	n (%)*
Seroma	2 (28.6)
Hematoma	2 (28.6)
Paresthesia at six weeks	2 (28.6)
Groin pain at six weeks	3 (42.9)
Superficial infection	2 (28.6)
Urinary incontinence	1 (14.3)
Testicular swelling	1 (14.3)
Blood with ejaculation	1 (14.3)
Hernia recurrence	0 (0)

*Some patients had multiple complications.

DISCUSSION

This study aimed to determine differences in infection and recurrence rates in IHRs by repair type at a small rural hospital. While patient and procedure characteristics for a two-year period were described, the low volume of total IHRs limited the ability to apply statistical tests. However, clinical findings are discussed below, as well as the relevance of findings to rural hospital engagement in surgical quality improvement and to this hospital's and community's economic well-beings.

In terms of clinical findings, the study showed a higher incidence of IHR in males, consistent with other reports in the literature.^{11,12} Due to the physiologic (embryologic) process, right indirect inguinal hernias occurred more often than left, because the right testicle takes longer to descend than the left and the processus vaginalis longer to obliterate.¹¹ No difference was found in incidence of right versus left hernia in this study, as they were nearly-equal in the sample.

Studies have demonstrated comparable outcomes between general hospitals and dedicated hernia repair centers.¹³ Seven patients in our study experienced post-operative complications; however, these were all minor. An example of major complication would encompass returning to the operating room and/or admittance to the hospital for extensive care. The most common complication was groin pain at six weeks post-operative. There were only two superficial infections after open hernia

repairs, and neither warranted removal and replacement of mesh.¹⁴ No patients experienced inguinal hernia recurrences. This suggested that, in general, the quality of hernia operations at this hospital was good. One study cited a complication rate for open hernia repairs as 21.0%.¹⁵ In another study, a review of 1,034 IHRs found that urgent or emergent repairs had a complication rate of 27%.¹⁶ In comparison, elective repairs were found to have a complication rate of 15.1%.

Reducing quality measurement to percentages in rural surgery is problematic given its inherent low volumes.¹⁷ The surgeon with the highest volume during our study period performed 39 hernia repairs and had a complication rate of 28.2%. One less complication would have lowered the rate to 25.6%, a difference of 2.6 percentage points. In a larger center, a surgeon performing 200 hernia repairs a year would experience only a 0.5 percentage point change for every one complication.

When potential risk-factors for post-operative complications were examined, the three of the seven patients who had complications were current smokers. In previous studies, smoking had been shown to be a modifiable risk factor for complications following hernia repair.^{10,18} There were two patients who together cumulated 6 of the 14 total complications. Both of these patients had morbid obesity (a BMI of ≥ 40), which also has been shown to be a modifiable risk factor.^{10,19,20}

Hernia repairs are considered "bread and butter" in rural surgery.²¹ High-quality care remains the goal of all surgeons, but it should be acknowledged that quality's financial implications are growing as well. As quality measures become used more commonly in reimbursement policy, insurance contracting, and physician employment contracts, rural hospitals' ability to participate in quality improvement becomes increasingly crucial. Our rural hospital was a willing partner in this study, yet all were surprised by the difficulty of exporting and analyzing their data. Most rural hospitals do not have as many dedicated quality improvement personnel compared to their urban counterparts.²² In addition, rural hospitals struggled to obtain and maintain robust information technology systems that facilitate routine, thorough quality improvement efforts.^{17,23,24}

Given the importance of rural surgery to its hospitals and communities,²⁵ studies like these are important attempts to quantify rural surgical patient characteristics and surgeon performance. Nearly half of the procedures in our study were covered by private insurance. At the same time, 41.2% of patients were retired. This was explained, in part, by over one-third of patients utilizing both Medicare and private insurance coverage. This may mean that Medicare-eligible patients were working and covered by their employer-sponsored health benefits. Summing private coverage and dual Medicare/private coverage, 86.3% of these surgical patients were not Medicare-only patients. This proportion is in direct contrast to many rural hospitals, whose Medicare patients often exceed 60%.^{17,25}

Limitations. This study was limited by its construction as a retrospective chart review that yielded a small sample size and narrow

distribution across surgical procedures and surgeons. Future studies should examine data from multiple rural hospitals to increase sample size and allow for a more robust analysis and leverage the growth of hospital systems, which more commonly include smaller, more rural hospitals, and utilize shared electronic medical records to compare outcomes from rural and urban hospitals.

CONCLUSIONS

Studying surgical outcomes at rural hospitals is vitally important. Surgeons need to be cognizant of their outcomes, not only for their own quality improvement efforts but chiefly due to consequences to patients, such as morbidity and mortality. Findings from this project should be used to inform rural general surgeons of the potential infection and recurrence rates associated with IHR by open (plug-and-patch or Lichtenstein) and laparoscopic (TAPP) techniques. This adds to the body of literature regarding IHR infection and recurrence rates. Rural surgeons also should be conscious of the impact of low volumes on their quality measures; small changes in raw numbers can mean larger changes in percentages. Future studies could be performed to compare data from rural and urban hospitals and facilitate greater rural surgeon engagement in quality improvement efforts.

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