Hernia (2023) 27:1467–1472
https://doi.org/10.1007/s10029-023-02754-7

ORIGINAL ARTICLE

Natural history of occult hernias in adults at a safety-net hospital

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Received: 7 November 2022 / Accepted: 3 February 2023 / Published online: 16 February 2023
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Abstract

Purpose Occult hernias, hernias seen on radiologic imaging but not felt on physical exam, are common. Despite their high prevalence, little is known about the natural history of this finding. Our aim was to determine and report on the natural history of patients with occult hernias including the impact on abdominal wall quality of life (AW-QOL), need for surgery, and risk of acute incarceration/strangulation.

Methods This was a prospective cohort study of patients who underwent a computed tomography (CT) abdomen/pelvis scan from 2016 to 2018. Primary outcome was change in AW-QOL using the modified Activities Assessment Scale (mAAS), a hernia-specific, validated survey (1 = poor, 100 = perfect). Secondary outcomes included elective and emergent hernia repairs.

Results A total of 131 (65.8%) patients with occult hernias completed follow-up with a median (IQR) of 15.4 (22.5) months. Nearly half of these patients (42.8%) experienced a decrease in their AW-QOL, 26.0% were unchanged, and 31.3% reported improvement. One-fourth of patients (27.5%) underwent abdominal surgery during the study period: 9.9% were abdominal procedures without hernia repair, 16.0% involved elective hernia repairs, and 1.5% were emergent hernia repairs. AW-QOL improved for patients who underwent hernia repair ($+11.2 \pm 39.7$, $p = 0.043$) while those who did not undergo hernia repair experienced no change in AW-QOL (-3.0 ± 35.1).

Conclusion When untreated, patients with occult hernias on average experience no change in their AW-QOL. However, many patients experience improvement in AW-QOL after hernia repair. Additionally, occult hernias have a small but real risk of incarceration requiring emergent repair. Further research is needed to develop tailored treatment strategies.

Keywords Hernia · Occult hernia · Computed tomography · Hernia repair

Introduction

Traditionally, hernias were diagnosed with history and physical exam. Computed tomography (CT) is becoming more commonly used and these are more sensitive than physical exam at identifying hernias as factors such as obesity and previous abdominal surgery can make the diagnosis of a hernia based on physical exam more difficult [1–3]. With the widespread use of CT, abdominal wall hernias are increasingly being diagnosed incidentally through radiographic imaging.

Occult hernias are hernias that are observed on radiologic imaging or at the time of surgery but not detected during a physical exam. These hernias are often considered an incidental finding and are seen in 40% of Americans undergoing abdominal radiographic imaging [4]. Little is known about the natural history of patients with occult hernias. Previous studies have found that patients with occult hernias have a lower baseline abdominal wall quality of life (AW-QOL) compared to patients with no hernia [4]. However, no data exists on the natural history of patients with occult hernias including change in AW-QOL, need for surgery, and risk of acute incarceration/strangulation [4, 5].

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Our aim was to determine and report on the natural history of patients with occult ventral hernias including the impact on AW-QOL, need for surgery, and risk of acute incarceration/strangulation.

Methods

This single-center, prospective, cohort study was performed as part of a larger prospective trial [6]. Institutional review board approval was obtained prior to the start of the project and the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines were followed for data collection [7].

Patients presenting to the surgery clinic and radiology departments for CT abdomen/pelvis between 2016 and 2018 were assessed for enrollment and consented for the study. Inclusion criterion was all adult patients (≥ 18 years old) and exclusion criterion was patients with a primary language outside of English and Spanish (due to study tools being validated for English and Spanish only). Patients who voluntarily agreed to participate provided informed, written consent.

At enrollment, all patients underwent a standardized abdominal exam to identify any clinically apparent ventral hernia prior to undergoing their scheduled CT scan. This exam was performed by a surgeon trained and verified by a high-volume hernia surgeon at the start of the study. Patients were additionally asked to complete a modified Activities Assessment Scale (mAAS) survey to establish their baseline AW-QOL during this appointment and prior to undergoing their CT scan (eTable 1) [8–10]. This 12-question validated, hernia-specific AW-QOL survey considers three domains of quality of life: physical activity, social wellbeing, and psychological wellbeing. Results of this survey are normalized to a scale from 1 to 100, where 1 equals poor AW-QOL and 100 equals "perfect" AW-QOL. Normal is defined as 80 and above and the minimal clinically important difference (MCID) is 5 for a minor change and 15 for a major change [11].

Both a radiology and surgery attending, blinded to the abdominal examination results, reviewed all the CT scans with special emphasis on identifying abdominal wall hernias and those found to have an occult ventral hernia, including primary and incisional, were included in this study. Discrepancies in the interpretations of the CT scans between the reviewers were discussed and resolved with the senior author. Patients were only offered elective hernia repair if they became symptomatic during the study.

One-year post enrollment, all patients with an occult hernia were contacted by phone for a follow-up assessment of their AW-QOL. Patients were informed that they had an occult hernia during this phone follow-up. For the purposes of this study, an occult hernia was defined as a hernia noted on radiographic examination but not on clinical examination. Patients were questioned regarding any new diagnoses or surgeries since enrollment and asked to repeat the mAAS survey.

The primary outcome was change in AW-QOL of patients with occult hernias. Secondary outcomes included subsequent abdominal surgeries, elective hernia repairs, and emergent hernia repairs.

Patients were analyzed overall and comparing those who underwent hernia repair or not. Additionally, change in AW-QOL was analyzed in both as continuous variables as well as categories using the MCID of seven into worsened, unchanged, and improved groups to account for inter-patient variability in scoring on mAAS survey. Categorical variables were reported as frequencies and percentages. Continuous variables were reported as mean ± standard deviation if the data were normally distributed or as a median and interquartile range (IQR) if the data were not normally distributed. Categorical outcomes were compared using Fisher's exact test while continuous variables were compared using unpaired *t* test or paired *t* test. A regression of follow-up AW-QOL as the dependent variable adjusted for numerous independent variables including age, sex, body mass index (BMI), previous abdominal surgeries, subsequent abdominal surgeries, and hernia repairs was performed. Statistical significance was set at $p < 0.05$. All statistical analyses were performed using STATA software version 16.

Results

A total of 525 patients were approached and 498 patients were enrolled in the study. Among those enrolled, 199 patients had occult hernias, 159 had no hernias, and 140 had clinical hernias. The 199 patients with an occult hernia formed the patient cohort for this study. Follow-up was completed by 131 (65.8%) patients with occult hernias with a median follow-up time of 15.4 months (IQR 22.5). An additional 12 (6.0%) patients died and 56 (28.2%) patients were lost to follow-up (Fig. 1).

Most patients were female (64.9%) and of Hispanic ethnicity (74.0%) with an average age of 51 years. The majority had a BMI ≥ 30 kg/m^2 (52.7%) and had a prior abdominal surgery (61.1%).

A total of 36 patients (27.5%) underwent abdominal surgery between enrollment and follow-up, 23 (17.6%) were hernia repairs. Among the 23 hernia repairs, 14 (60.9%) were performed during another procedure, 7 (30.4%) were performed as an elective hernia repair, and 2 (8.7%) were performed as an emergency procedure. The two patients who needed emergency surgery were 47 and 51 years old at the time of surgery, female gender, and had prior abdominal surgery. Their hernias were a 17 × 20 cm multi-focal area

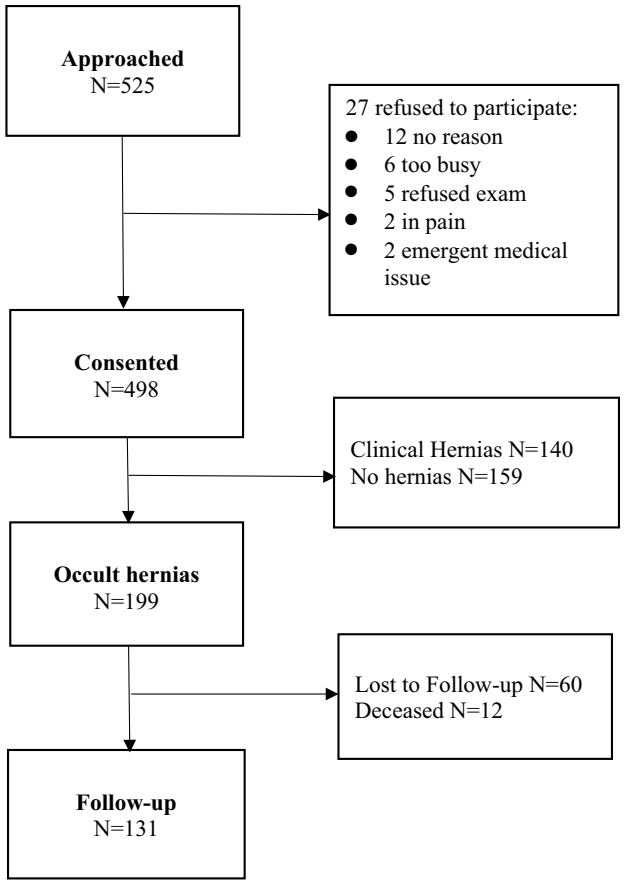

Fig. 1 Patient enrollment flow chart

with smaller defects (largest defect was 5 cm) and 4 × 5 cm in size. Both patients were obese (BMI 39 and 38). Both patients underwent emergency hernia surgery for acute bowel obstruction and bowel was viable in both cases.

Comparing patients who had hernia repairs versus those who did not, there was a significant difference in the percentage of patients with prior abdominal surgery (82.6% vs 56.5%, $p = 0.010$) and patients undergoing repair had larger hernias (area 1.4 cm^2 vs 0.7 cm^2, $p = 0.005$). The remaining baseline characteristics were similar (Table 1).

At baseline, the overall group had AW-QOL of 67.0 ± 31.7 and over time, experienced a slight decrease that was not statistically or clinically significant (follow-up 66.5 ± 30.4, change − 0.5 ± 36.2, 95% CI − 6.77 to 5.75, $p = 0.873$). Patients who had their hernias repaired reported a baseline AW-QOL of 59.7 ± 35.3 and experienced a clinically significant increase in their follow-up AW-QOL (follow-up 71.0 ± 26.6, change + 11.2 ± 39.7, 95% CI − 5.95 to 28.4, $p = 0.189$). In comparison, patients who did not undergo hernia repair had higher baseline AW-QOL (68.6 ± 30.9) but experienced no statistically or clinically significant change in follow-up AW-QOL (follow-up 48.9 ± 33.2, change − 3.0 ± 35.1, 95% CI − 9.71 to 3.69, $p = 0.375$). The change in AW-QOL between the two study groups was statistically and clinically significant (+ 11.2 ± 39.7 vs − 3.0 ± 35.1 $p = 0.043$) (Table 2). On regression, undergoing hernia surgery (coefficient 8.5, 95% − 4.4 to 21.5, $p = 0.196$) was clinically but not statistically associated with follow-up AW-QOL when adjusted for baseline AW-QOL.

Table 1 Baseline characteristics of occult hernia patients

Characteristics	Overall $N = 131$	Hernia repair group $N = 23$	No hernia repair group $N = 108$	p value
Age*	50.7 (11.6)	48.2 (9.3)	50.5 (11.9)	0.192
Sex				
Female	85 (64.9%)	16 (69.6%)	69 (63.9%)	0.304
Male	46 (35.1%)	7 (30.4%)	39 (36.1%)	
Ethnicity				
Hispanic	97 (74.0%)	19 (82.6%)	78 (72.2%)	0.267
African American	18 (13.7%)	1 (4.3%)	17 (15.7%)	
White	15 (11.5%)	3 (13.0%)	12 (11.1%)	
Asian	1 (0.8%)	0 (0%)	1 (0.9%)	
BMI**	29.9 (8.0)	33.0 (7.8)	30.1 (8.0)	0.229
BMI > 30	69 (52.7%)	15 (65.2%)	54 (50.0%)	0.094
Prior abdominal surgery	80 (61.1%)	19 (82.6%)	61 (56.5%)	0.010
Prior hernia repair	2 (1.5%)	1 (4.3%)	1 (0.9%)	0.114
Hernia size (cm)**				
Width	0.9 (0.8)	1.4 (1.7)	0.9 (0.8)	0.004
Length	0.8 (1.0)	1.0 (3.8)	0.8 (0.6)	< 0.001
Area	0.7 (1.5)	1.4 (1.0)	0.7 (1.2)	0.005

*Mean (SD)

**Median (IQR)

Despite a minor mean change in AW-QOL, most patients reported a clinically significant decrease in their AW-QOL over time (42.7% worsened, 26% were unchanged, and 31.3% improved). Among patients who underwent hernia repair, most patients experienced an improved AW-QOL (30.4% worsened, 26.1 were unchanged, and 43.5% improved). In contrast, among patients who did not undergo hernia repair, 45.4% worsened, 26.0% were unchanged, and 28.7% improved ($X^2 = 6.44$, $p = 0.04$) (Table 3).

On multivariate regression, no correlation between follow-up AW-QOL or any of the baseline variables was noted except for baseline AW-QOL.

Table 3 Change in AW-QOL by subgroup

	Overall $N = 131$ (%)	Subgroups	
		Hernia repair $N = 23$ (%)	No hernia repair $N = 108$ (%)
Improved	41 (31.3)	10 (43.5)	31 (28.7)
Unchanged	34 (26.0)	6 (26.1)	28 (25.9)
Worsened	56 (42.8)	7 (30.4)	49 (45.4)

Discussion

Among patients with occult hernias, there was no clinically important change in AW-QOL over the course of a year. However, there was an effect modifier: patients who underwent hernia repair experienced an improvement in their AW-QOL while those who did not undergo repair experienced no change. Most importantly, two patients with an occult hernia required emergency surgery as a result of their occult hernia.

Patients with a lower baseline AW-QOL were more likely to undergo hernia repair and this hernia repair resulted in a clinically and statistically significant improvement in AW-QOL. However, the results are short-term, and it is unclear if these repairs are durable in the long-term and if the improvements in AW-QOL are sustainable. Studies with long-term follow-up have suggested that hernia recurrence rates may approach 50–70% at 5–10 years of follow-up. As patients undergo more hernias repairs, the overall AW-QOL may also decline with time. There is also a possibility the improvement in AW-QOL after hernia repair was a placebo effect rather than a real change. Unfortunately, the concept of placebo effect is difficult to assess in surgical patients when comparing treatment versus no treatment as blinding the patient to the therapy is usually impossible. Even "placebo surgery" such as diagnostic laparoscopy with no hernia repair is fundamentally different than non-operative or expectant management, so we were unable to assess the placebo effect in this study [12].

Both patients who developed acute incarceration of bowel contents in their hernia requiring emergency surgery were obese. Had they not been obese, their hernias might have been detected on physical examination. In this study, an occult hernia was defined as a hernia detected on imaging but not on physical exam; however, there is some controversy over the definition of occult hernias in the literature [2, 4, 5]. It has also been defined as symptomatic but not palpable on physical examination or found on surgical exploration but not on physical exam [1]. This raises the question of how should symptomatic be defined, because although some of the patients in the study did not experience traditional symptoms such as pain, they had a lower AW-QOL than those who did not have an occult hernia which could be considered symptomatic [4]. Should the definition of occult hernia be changed, should larger occult hernias be repaired, and should bowel containing occult hernias be repaired? Future studies are needed to define asymptomatic versus symptomatic and to identify when oligosymptomatic hernias should be treated operatively. Future studies can aim to develop a Markov model and an algorithm of clinical recommendations for management of occult hernias as this is beyond the scope or ability of the current study.

As occult hernias may be found on imaging or during surgical exploration, their prevalence depends on the definition used and who is reading the CT scans. Additionally, some radiologists will not comment on occult hernias in their report; however, they are identified during surgery, which leads to false positives and false negatives. Depending on the indication for CT scan, radiologists may not look for occult hernias when reading it or will not include them

Table 2 Change in AW-QOL

	Overall $N = 131$	Subgroups		p value
		Hernia repair $N = 23$	No hernia repair $N = 108$	
Baseline AW-QOL*	67.0 (31.7)	59.7 (35.3)	68.6 (30.9)	0.112
Follow-up AW-QOL*	66.5 (30.4)	71.0 (26.6)	48.9 (33.2)	0.222
Change in AW-QOL*	− 0.5 (36.2)	+ 11.3 (39.7)	− 3.0 (35.1)	0.043

AW-QOL abdominal wall quality of life

*Mean (SD)

in their report, which is why it is important for surgeons to look at the imaging themselves [13, 14]. For these reasons, in this study, both a radiologist and a surgeon read the CT scans to identify occult hernias.

There are very few studies on prevalence of occult hernias in the literature. Bedewi et al. [15] found the prevalence of occult paraumbilical hernias on ultrasound was 25%, Olavarria et al. [4] found a prevalence of 40% seen on CT, and Deerenberg et al. [16] found 49% of patients had a ventral incisional hernia on imaging at one-year post-operative. Although there have not been many studies on occult ventral hernias, there are a few studies on occult inguinal hernias. It has been shown that the incidence of inguinal hernias is similar to that of ventral hernias and can be as high as 50% [1, 17]. This discovery of an occult inguinal hernia on the contralateral side during laparoscopic inguinal hernia repair is an example of the alternate definition of occult hernias (found on surgical exploration but not on physical exam). Van den Heuvel et al. [17] followed patients with occult inguinal hernias for a mean of 112 months and found one of five will become symptomatic and require repair. Although traditional teaching is to not repair the contralateral side if it is asymptomatic, repairing the contralateral side would prevent the need for another operation in nearly one in three patients [18–20]. Unfortunately, long-term and randomized trials like these have not been done for ventral occult hernias.

It is unclear which patients with occult hernias should undergo abdominal surgery. Among the two patients who required emergency surgery, both were obese and poor candidates for elective ventral hernia repair. Alternatively, to prevent an emergency surgery, it is possible that elective surgery may be beneficial in certain cases such as these. Prior research has suggested that patients with bowel containing hernias or hernias at risk for bowel incarceration (medium neck with large hernia sac) may be prone to need emergency surgery. Unfortunately, high-risk patients are more likely to suffer complications from elective surgery and are more likely to require emergency hernia repair, and the risks and benefits of elective surgery should be weighed in these cases. Randomized trials are needed to assess the role of elective surgery versus expectant management in these high-risk patients.

Among patients undergoing elective surgery for their occult hernias, it is unknown who would benefit from early elective surgery. Patients who underwent elective surgery had lower baseline AW-QOL, were more likely to be obese, have an incisional hernia, and have a larger hernia. Similar to preventing emergency surgery, patients at highest risk for complications from elective hernia surgery are also those who are most likely to have worse baseline AW-QOL and are most likely to benefit, at least in the short term, from hernia repair. Trials are needed to determine the risks and benefits of treatment among these patients.

This study has several limitations. To our knowledge, it is the first study to assess the natural history among a group of patients with occult hernias. However, it is a single-center study of low-socioeconomic, largely Hispanic patients so the generalizability of these results to other patient populations is unclear. Additional studies of different populations are needed. In addition, while the study design is optimal to assess the natural history, it does not assess who would benefit from intervention. We chose not to perform a randomized controlled trial because we did not feel elective surgery on high-risk patients without attempting risk modification first was an optimal first study to perform as this group of patients is at a high risk for complications. However, it appears that operative management in these patients improve their AW-QOL. Randomized controlled trials to determine appropriate management could be performed on lower-risk patients with occult hernias. Finally, this study had short-term follow-up with a median of 15 months, so long-term studies are needed to study the history of occult hernias.

Conclusion

Occult hernias are not simply incidental findings as was previously thought. They have a negative impact on patient quality of life and have a real risk for incarceration/strangulation. Randomized controlled trials are needed to identify the optimal management strategy for patients with occult hernias noted on CT scan. Until that time, physicians should have informed conversations with patients with occult hernias on their management options and the risks and benefits of those choices.

Supplementary Information The online version contains supplementary material available at https://doi.org/10.1007/s10029-023-02754-7.

Funding No funding was received for this study.

Declarations

Conflict of interest The authors declare that they have no conflict of interest to disclose.

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