Traumatic abdominal wall hernias: Location matters

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BACKGROUND: Because of its uncommon nature and a lack of comprehensive literature, abdominal wall hernias caused by blunt trauma continue to present a management dilemma. This study was performed to identify the incidence of associated injuries, the need for urgent operative intervention, and recurrence rates after hernia repair.

METHODS: A retrospective review of patients diagnosed with a traumatic abdominal wall hernia from January 2002 to December 2014 was performed. Data were collected from the trauma registry and included patient demographics, location and type of hernia, associated injuries, operative interventions, complications, and length of stay.

RESULTS: Eighty patients (64% male; median age, 36 years; mean Injury Severity Score [ISS], 22) were identified during the study period. A motor vehicle collision was the most frequent mechanism of injury (n = 58). Overall, 35 patients (44%) underwent urgent laparotomy or laparoscopy, and 10 of these (29%) were nontherapeutic excluding hernia repair. Of interest, 17 patients (49%) required bowel resection. Notably, the need for operative intervention and nontherapeutic rate differed depending on hernia location. Hernia repair was performed in 23 patients, the majority of whom (78.3%) underwent repair within 5 days of injury. There were six recurrences, four of which were repaired acutely (within 1 week of injury), with an overall first-time hernia recurrence rate of 26%.

CONCLUSION: In the largest series to date, traumatic abdominal wall hernias were found to be associated with a high percentage of intra-abdominal injuries requiring urgent laparotomy or laparoscopy. Rates of therapeutic interventions varied by hernia location, with anterior abdominal hernias associated with the highest need for a therapeutic operation. Acute repair was associated with the majority of the recurrences. (*J Trauma Acute Care Surg.* 2016;80: 390–397. Copyright © 2016 Wolters Kluwer Health, Inc. All rights reserved.)

LEVEL OF EVIDENCE: Epidemiologic study, level III; therapeutic study, level IV.

KEY WORDS: Traumatic hernia; blunt trauma; abdominal wall hernia; traumatic abdominal wall hernia; hernia.

While uncommon, traumatic abdominal wall hernias (TAWHs) caused by blunt injury affect an estimated 15,000 patients every year. Despite affecting large numbers of patients, few outcome studies have been published, and those that have include few patients describing a variety of management techniques and patient outcomes.[1–4] Furthermore, there are no published guidelines regarding the optimal management strategy. Thus, management of TAWH represents a dilemma for most surgeons encountering this injury.

There are at least three areas of concern when managing a patient with a TAWH. The first clinical question is determining whether the mere presence of a TAWH mandates exploratory laparotomy. A high prevalence of concomitant injuries requiring operative intervention would suggest the need for mandatory laparotomy. If the prevalence is low, a more selective strategy may be warranted. The second management issue is with regard to the repair of TAWH. The existing literature is not clear on whether all TAWHs even need to be repaired. In addition, if repair is undertaken, debate exists as to its ideal timing. The third area of controversy surrounds the type of repair that should be performed. Whether mesh repairs are superior to tissue repairs and if synthetic or biologic mesh should be used are unanswered clinical questions.

This study documents the incidence of concomitant intra-abdominal injuries that require operative intervention in patients with TAWH. In addition, the complication rate of unrepaired hernias, the timing of repair, and the rate of recurrence after repair were determined.

PATIENTS AND METHODS

After approval by the institutional review board of Indiana University School of Medicine was obtained, patients admitted to the Indiana University Health (IUH) Methodist Level I trauma center from January 2002 to December 2014, were eligible for inclusion in this study if a TAWH was diagnosed at the time of admission. IUH Methodist, Indianapolis, Indiana, is the state's largest hospital and busiest trauma center, with more than 3,500 trauma admissions yearly with an average Injury Severity Score (ISS) of greater than 12. Moreover, IUH Methodist is a part of the IUH 10-hospital system. This hospital system cares for the majority of injured patients in the state via the IUH trauma system and shares a unified electronic medical record.

To identify patients with a TAWH, DORIS [Dig Our Radiology Information System], the HIPPA-compliant institutional radiology dictation system, was queried using a natural language processing search function. Search terms included *trauma and hernia*, *lumbar hernia*, *traumatic hernia*, *abdominal wall disruption*, and other variations. Since its initiation in 2001, DORIS now houses almost nine million examinations and dictations from the 10 hospitals within the IUH system. After initial identification from DORIS, patients were then cross-referenced using the institutional trauma registry to verify the traumatic nature of the hernia. Hernias resulting from penetrating trauma and patients who died within 24 hours of admission were excluded.

The electronic medical records as well as admission and operative notes were reviewed for each patient identified. Demographics and physiologic information were abstracted, as well as the information regarding the TAWH including the location, associated injuries, operative details, and outcomes. Furthermore, each computed tomography (CT) scan was independently reviewed by an attending radiologist to confirm the location and type of hernia. Hernia locations were described based on the major muscle group affected. If the primary muscle was the rectus abdominis, the hernia was classified as "anterior abdominal." Flank hernias were defined by the involvement of the oblique muscles, and lumbar hernias were defined by the occurrence within the superior or inferior lumbar triangle. A hernia repair was defined as either "acute" if it was performed within 2 weeks of injury or "delayed" if performed any time afterward. Data were analyzed using SPSS version 23 statistical analysis software (2015; IBM Corporation, Armonk, NY).

RESULTS

From January 2002 to December 2014, 80 patients with blunt trauma admitted to IUH Methodist Hospital were diagnosed

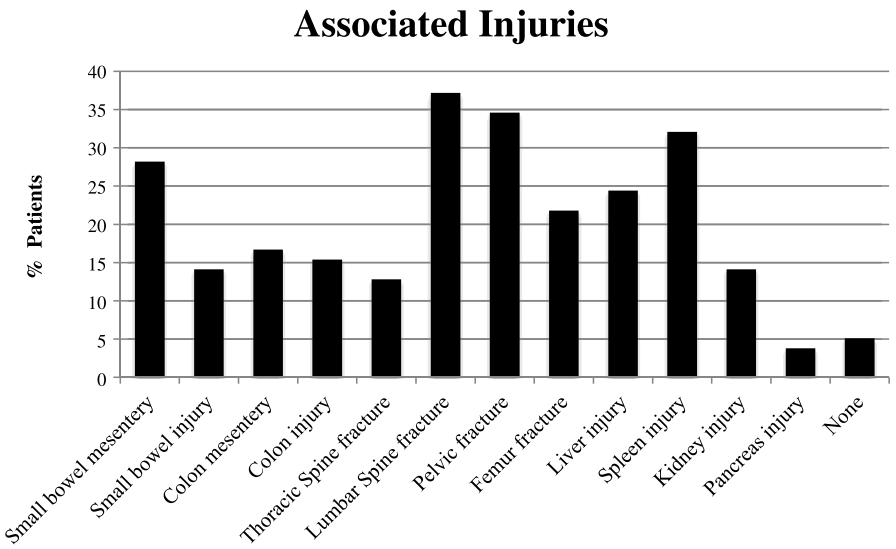

Figure 1. Injuries associated with traumatic abdominal wall hernias.

with a TAWH on a CT scan. These 80 patients constituted our study group and represent approximately 0.24% of all trauma admissions from 2007 to 2014. There were 50 male (62.5%) and 30 female (37.5%) patients. The median age of study patients was 38.6 years (range, 9–81 years), median ISS was 22, median Glasgow Coma Scale (GCS) score on admission was 13, and there were no deaths in the study group.

A motor vehicle collision (MVC) was the most common mechanism of injury, occurring in 58 patients (73.4%), 37 of whom used restraints. Of interest, 21 (56.8%) of these patients did have a seat belt sign on physical examination. Pedestrians struck by motor vehicles and patients of motorcycle collisions were the mechanism of injury for six patients each. The remaining patients were involved in bicycle accidents (n = 4), falls (n = 3), or crushed in work-related incidents (n = 2).

As shown in Figure 1, associated injuries were common, with only four patients identified as having no other injuries aside from the TAWH. Almost 40% of patients were diagnosed with fractures in the lumbar spine, making it the most common concomitant injury with a TAWH. Pelvic fractures and splenic injuries were found in 34.6% and 32.1% of patients, respectively. Hemoperitoneum was present on the admission CT scan in more than one third of the patients (34.6%). Overall, injuries to the bowel and its mesentery occurred in 29 patients (36%). These 29 patients were noted to have flank (n = 15), anterior (n = 7), or lumbar (n = 7) hernias.

No operative intervention was performed in 56% of the patients, while 35 patients (44%) did undergo an urgent laparotomy or laparoscopy for their injuries. Three of these patients were initially admitted and treated nonoperatively for their injuries but developed symptoms necessitating operative intervention. One patient had obstructive symptoms and was found to have an internal hernia of small bowel through a mesenteric defect. The other two patients developed increasing abdominal pain and were found to have ischemic intestine requiring resection. In 10 (28.6%) of the operations performed, no operative intervention or therapy was required excluding the acute hernia repair. Those with flank hernias had the highest proportion of laparotomies not requiring a therapeutic intervention (Fig. 2). Of the 31.3% of patients who had a laparotomy or laparoscopy

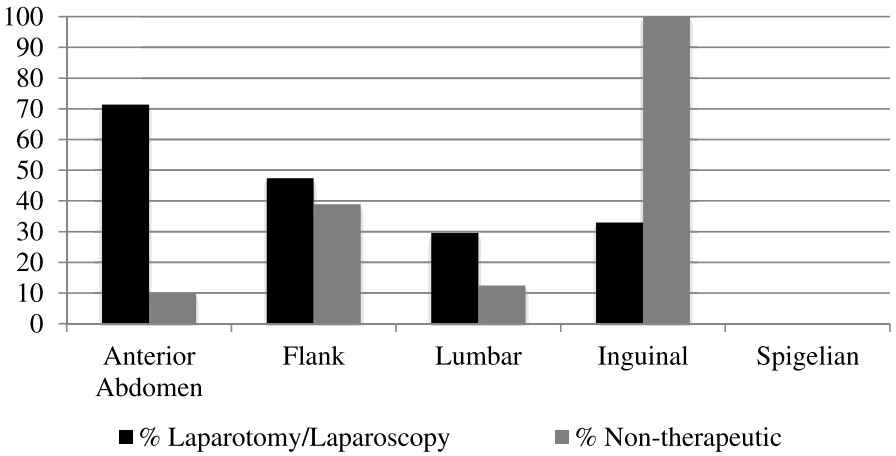

Figure 2. Operative intervention and therapeutic rates in traumatic abdominal wall hernias.

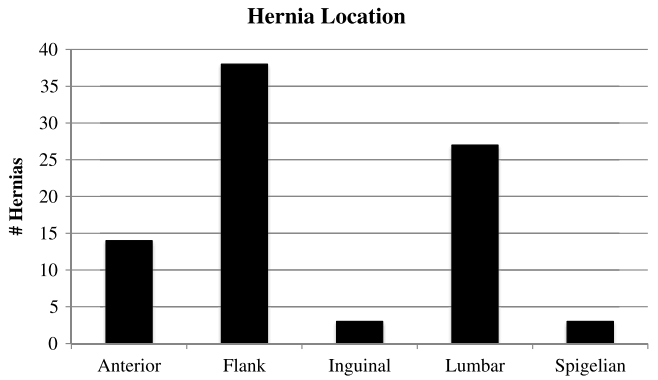

Figure 3. Anatomic locations of traumatic abdominal wall hernias.

in which treatment was required other than hernia repair, 17 (48.6%) underwent a bowel resection and 6 were treated with an open abdomen at the initial operation.

In the 80 patients in this review, 85 hernias were diagnosed, and 47.5% of those were found in the flank (Fig. 3). Lumbar hernias were identified in 27 patients and anterior abdominal hernias in 14. Traumatic Spigelian and inguinal hernias were the least frequently occurring, with three of these hernia types each diagnosed. Five patients in this study had hernias in more than one location, including four who had both anterior abdominal and flank hernias and one with both lumbar and flank hernias. Hernias were diagnosed on the right side in 47.5% of the patients and on the left side in 42.5%, and bilateral hernias were diagnosed in 10% of the patients. Of these, five had bilateral anterior abdominal hernias, one had bilateral flank hernias, one had bilateral lumbar hernias, and one had both a right anterior and a left flank hernia.

Overall, 23 patients underwent repair of a TAWH (Fig. 4). Primary closure was the most frequently used technique and was performed in 16 patients, while a mesh repair (synthetic, n = 4; biologic, n = 3) was performed in the remaining 7 patients. Recurrence after repair occurred in six patients (26.1%) (Table 1). One patient, however, was involved in a second significant MVC approximately 7 years after his first collision and TAWH repair. Both physical and radiologic findings were consistent with an acute recurrence of the hernia characterized by a subcutaneous contusion and stranding surrounding the mesh on CT of the abdomen. This patient has not undergone a repeat hernia repair. The other five patients with a recurrence were repaired with mesh (biologic, n = 2; synthetic, n = 3), and four of these patients developed a second recurrence (Fig. 4).

DISCUSSION

Abdominal wall hernias secondary to blunt trauma are a relatively uncommon event, with a reported incidence of less than 1% of all blunt trauma admission.[4–8] Despite TAWH being first reported in the literature more than 100 years ago, approximately 100 patients in total have been identified and described in the literature. In fact, the largest series to date included 38 patients.[4] These injuries continue to be difficult to diagnose on a physical examination in the acute setting; however, the increased use of CT scans in the evaluation of injured patients has led to an increased number of patients diagnosed with a TAWH soon after injury. Despite this, there is a continued lack of knowledge as to the incidence of associated injuries, the natural history of unrepaired hernias, and the ideal operative management of these injuries.

While affecting more than 15,000 patients approximately every year, the incidence of TAWH at a single trauma center is relatively low. Previously reported incidences have ranged from 0.17% to 1.5%.[4,7] In this study, there was an incidence of 0.24% during the 12-year study period, and 95% of the patients had associated injuries. Overall, patients with TAWH are moderately to severely injured, with a reported median ISS ranging from 17 to 31 in previous studies and 22 in this study.[1,4]

One of the purposes of this study was to determine if a mandatory laparotomy is warranted for patients with a TAWH. To begin to answer this question, it is important to consider the incidence of injuries that need to be addressed via laparotomy or laparoscopy. The proportion of patients with an injury to the bowel in this study differed slightly in comparison with what was reported by Honaker and Green.[4] In that series of 38 patients, mesenteric or direct injuries of the small bowel or

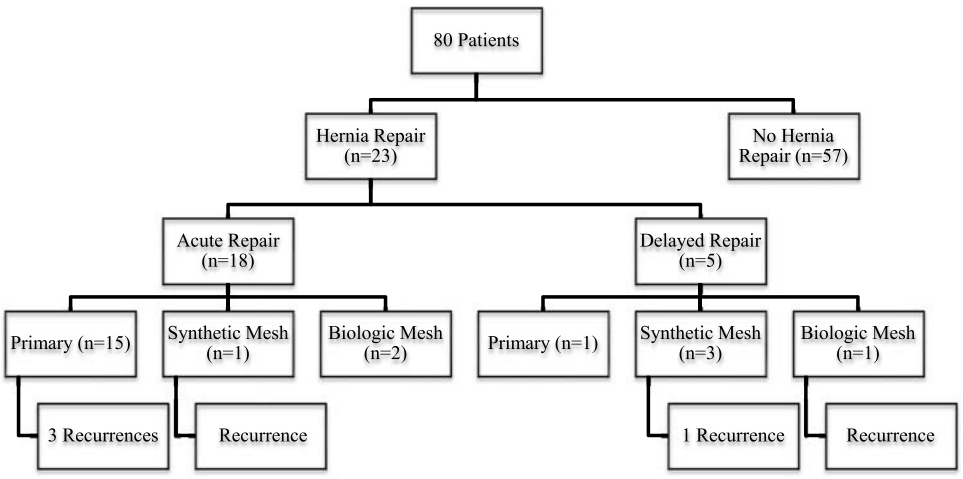

Figure 4. Types of repair and recurrences in repaired traumatic abdominal wall hernias.

TABLE 1. Management of Recurrent Traumatic Abdominal Wall Hernias

Patient Number	Type of Hernia	Timing of Initial Repair	Type of Incision	Type of Repair	Postoperative Complication?	Timing of Recurrent Repair	Type of Incision	Type of Repair	Postoperative Complication?	Recurrence
6	Left flank	Acute	Midline	Primary	SSI	Acute	Midline	Biologic	None	Yes
31	Left flank	Acute	Midline	Primary	SBO	Delayed	Midline	Biologic	SSI	Yes
61	Right flank	Delayed	Flank	Biologic	None	Delayed	Flank	Synthetic	SSI	No
73	Right flank	Acute	Midline	Primary	None	Acute	Midline	Synthetic	SBO, ECF	Yes
80	Left lumbar	Delayed	Flank	Biologic	None	Delayed	Flank	Synthetic	None	Yes
81	Right lumbar	Acute	Midline	Synthetic	SSI	N/A				

Patient 81 acutely recurred after a second MVC 7 years after the first MVC during which the hernia occurred.
ECF, enterocutaneous fistula; SBO, Small bowel obstruction; SSI, Surgical Site Infection.

colon were reported in 53% of their patients in comparison with 36% in this review.[4] While Burt et al.[5] reported mesenteric injury as the most frequent concomitant injury, with 36% of patients being affected, the most commonly associated injuries in our series were fractures of the lumbar spine (37.2%), followed by pelvic fractures and splenic injuries. In addition, there is a marked difference between previous reports and this review with regard to the number of patients who underwent acute operative intervention. In the series reported by Honaker and Green,[4] 68.4% of the patients underwent operations to repair injuries

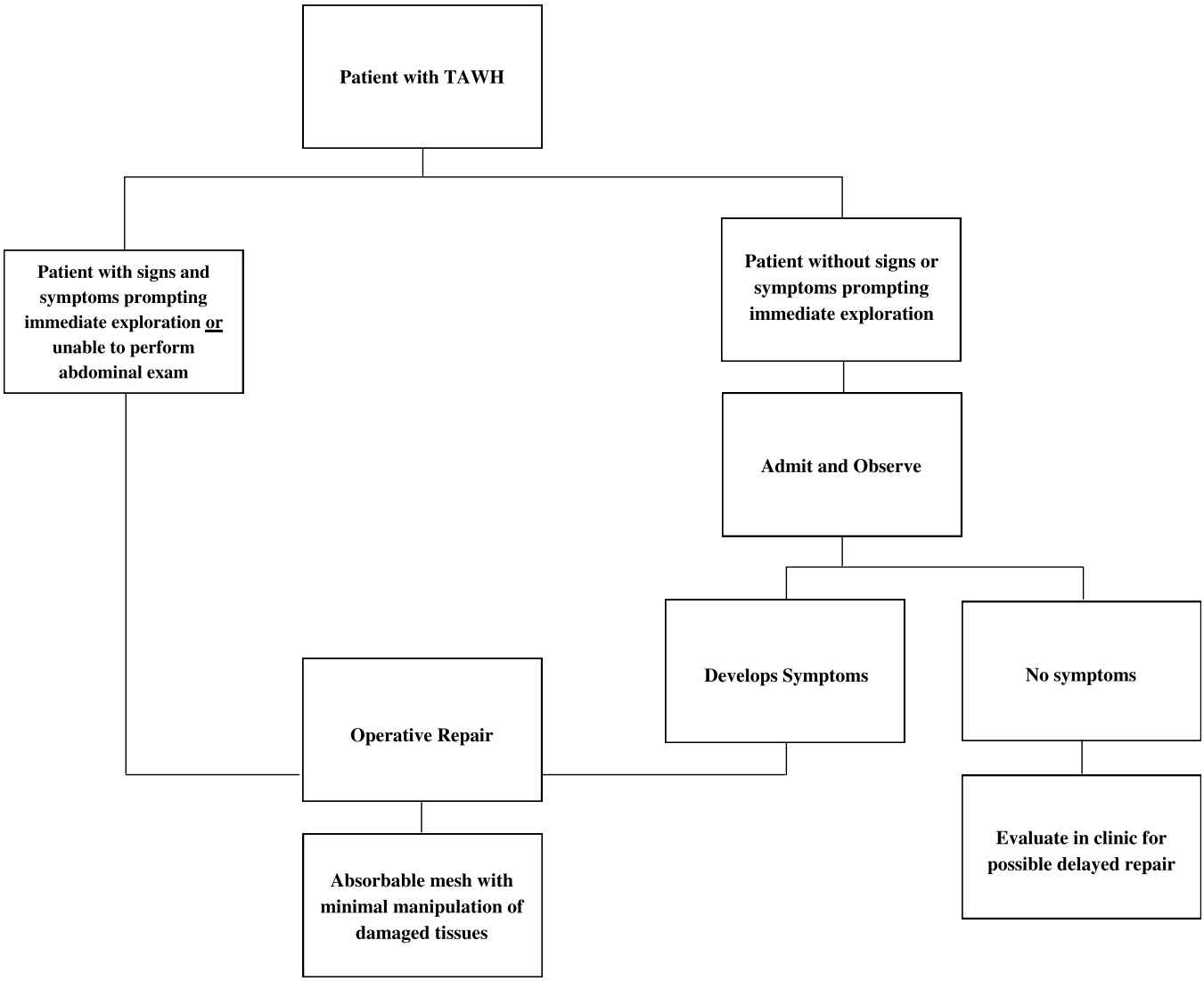

Figure 5. Treatment algorithm.

other than the TAWH. Lane et al.[9] reported that 100% of patients with TAWH secondary to high-velocity mechanisms of injury were found to have injuries requiring operative intervention. Liasis et al.[2] documented that 53% of the patients required operations for injuries other than the TAWH. In comparison, the rate of operative intervention in this review was only 44%. Overall, only 31% of the patients diagnosed with a TAWH underwent an operation that required an intervention other than hernia repair. Therapeutic operations were more likely to be performed in patients with anterior abdominal wall hernias. Conversely, otherwise nontherapeutic operations were more commonly performed in patients with flank hernias.

Despite the prevalence of associated injuries, Netto et al.[1] noted that 24 (70.6%) of 34 patients diagnosed with a TAWH were managed nonoperatively. Two of these patients did develop symptoms and were repaired approximately 8 months after injury. With a range of follow-up between 1 month and 16 months, the remaining 22 patients (64.7%) developed no symptoms or complications related to the hernia. In this series, 71.3% of the patients did not undergo an operative repair, and with a similar range of follow-up, none has developed any symptoms or complications from the hernia. Given this information and the relatively large number of otherwise nontherapeutic operations performed, mandatory operative exploration for patients with TAWH without another clinical indication for exploration is not recommended.

There have been different recommendations for the timing of the hernia repair in previous reports. Although immediate repair has been recommended in earlier studies as referenced earlier, recent articles have suggested repair outside of the acute setting as the preferred approach.[1,3,4,9–11] In the two largest series before this one, Netto et al.[1] and Honaker and Green[4] both reported increased recurrence rates in patients undergoing an acute repair. For example, Netto et al.[1] observed a 50% recurrence rate in patients in whom hernias were fixed acutely. Although Honaker and Green[4] did report a low recurrence rate of 8.3%, all of these occurred in patients with repairs performed in the acute stage. In this review, there was a considerably higher overall recurrence rate of 26%. In contrast to the report from Honaker and Green[4] in which all recurrences were in lumbar hernias, the majority (67%) of recurrent hernias in this report were in the flank. Of the five patients who underwent a delayed repair, three recurred. Because of the relatively small number of patients who had an acute repair of the TAWH in this series, no recommendation can be made about the optimal timing.

Once the decision to proceed with a repair is made, it is important to consider the type of repair that will be undertaken. Brenneman et al.[8] strongly recommended the use of autogenous tissue unless technically prohibitive. In that particular study, tensor fascia lata, rectus femoris, rectus abdominis fascia, and latissimus dorsi muscle were all used for tissue-only repairs in a delayed setting. Conversely, Honaker and Green[4] recommended that repairs specifically be performed with a synthetic mesh as they noted a 0% recurrence rate in patients after such repairs. In this review, 3 of 15 patients who underwent a tissue repair in the acute setting developed a recurrent hernia. Overall, three patients were fixed with biologic mesh (one acutely, two delayed) with one recurrence, and there were two recurrences in the four patients repaired with synthetic mesh (one acutely, three delayed). The circumstances of one recurrence in the synthetic mesh group, however, were unusual as previously noted. No matter the cause, once a repair fails, it can be a difficult problem to fix. In the current study, four of the five hernias that recurred were repaired a second time and suffered a second recurrence. Overall, because of the relatively small numbers of recurrences, no recommendations can be made at this time with regard to the preferred mesh material, although general trends point toward mesh as the preferred approach over tissue only repairs.

There are several limitations of this study. As with all retrospectively collected data, there is the potential for missing data, loss of follow-up, and misclassification. Because patients were retrospectively identified and since there is no DRG International Classification of Diseases—9th Rev. code for TAWH, we had to rely on DORIS to identify patients with TAWH. The trauma registry served as a cross-reference only, not as the primary means to identify patients; however, DORIS represents a complete compilation of all dictation reports for every radiologic study performed at IU Health Methodist hospital since 2001. In addition, the database was queried with both general and very specific search terms to allow for an initially broad patient population. This data set was then narrowed on review of the medical records, secondary review by an attending radiologist, and cross-reference with the trauma registry. Next, while the electronic medical record number at IU Health is unified and covers both the inpatient and outpatient settings at 10 hospitals throughout the state of Indiana, it is possible that patients who had complications were seen at a hospital outside of the IU Health system. If a patient had a complication and was indeed seen at another facility, it is possible that we could misclassify this patient as having had no complication. Lastly, the data in this study were from a period of 12 years, resulting in a variety of CT scanners being used as the technology evolved. The CT scanners used ranged from 4- to 64-slice scanners, resulting in increased resolution of images over the time span of the study. This could have led to an increase in the diagnosis of a small TAWH as the study progressed.

Despite these limitations, this study is the largest single-institution series of TAWHs to date. These were found to be highly associated with other injuries, many of which do not always require operative repair. The current local management protocol for patients with TAWH is observation if the patient does not have hemodynamic instability or peritonitis. Patients should initially be kept nil per os and a diet slowly advanced, while serial abdominal examinations are performed. If no symptoms develop, the patient may be discharged with close follow-up in the clinic for evaluation of a possible delayed repair. For patients in the acute setting, whether being operated on for symptoms or associated injuries, all other injuries should receive priority over the hernia. When the other intra-abdominal injuries have been addressed, the hernia should be evaluated. The first step in this evaluation is to determine whether the intra-abdominal contents are herniated. If they are not herniated, no intervention for the TAWH is recommended. If the intra-abdominal contents are not contained and prolapsing into the hernia space, a loose and wide placement of absorbable mesh is performed with minimal manipulation of the damaged abdominal wall. These patients are then followed up after discharge for consideration of a definitive repair at a later date, once the acute injuries have healed.

Unfortunately, other questions about the ideal management of TAWH are still yet to be answered. To adequately address these questions, a multicenter, prospective observational study is needed.

AUTHORSHIP

J.J.C., B.L.Z., B.L.B., and R.L.R. designed this study. J.J.C., E.K.F., S.D.S., and B.L.B. contributed to the data acquisition. J.J.C., E.K.F., B.L.Z., S.D.S., and D.V.F. performed the data analysis. J.J.C., E.K.F., B.L.Z., and D.V.F. contributed to the interpretation of data.

DISCLOSURE

The authors declare no conflicts of interest.

REFERENCES

1. Netto FA, Hamilton P, Rizoli SB, Nascimento B Jr, Brenneman FD, Tien H, et al. Traumatic abdominal wall hernia: epidemiology and clinical implications. *J Trauma*. 2006;61(5):1058–1061.
2. Liasis L, Tierris I, Lazarioti F, Clark CC, Papaconstantinou HT. Traumatic abdominal wall hernia: is the treatment strategy a real problem? *J Trauma Acute Care Surg*. 2013;74(4):1156–1162.
3. Esposito TJ, Fedorak I. Traumatic lumbar hernia: case report and literature review. *J Trauma*. 1994;37(1):123–126.
4. Honaker D, Green J. Blunt traumatic abdominal wall hernias: associated injuries and optimal timing and method of repair. *J Trauma Acute Care Surg*. 2014;77(5):701–704.
5. Burt BM, Afifi HY, Wantz GE, Barie PS. Traumatic lumbar hernia: report of cases and comprehensive review of the literature. *J Trauma*. 2004;57(6): 1361–1370.
6. Faro SH, Racette CD, Lally JF, Wills JS, Mansoory A. Traumatic lumbar hernia: CT diagnosis. *AJR Am J Roentgenol*. 1990;154(4):757–759.
7. Dennis RW, Marshall A, Deshmukh H, Bender JS, Kulvatunyou N, Lees JS, Albrecht RM. Abdominal wall injuries occurring after blunt trauma: incidence and grading system. *Am J Surg*. 2009;197(3):413–417.
8. Brenneman FD, Boulanger BR, Antonyshyn O. Surgical management of abdominal wall disruption after blunt trauma. *J Trauma*. 1995;39(3): 539–544.
9. Lane CT, Cohen AJ, Cinat ME. Management of traumatic abdominal wall hernia. *Am Surg*. 2003;69(1):73–76.
10. Mahajna A, Ofer A, Krausz MM. Traumatic abdominal hernia associated with large bowel strangulation: case report and review of the literature. *Hernia*. 2004;8(1):80–82.
11. Gill IS, Toursarkissian B, Johnson SB, Kearney PA. Traumatic ventral abdominal hernia associated with small bowel gangrene: case report. *J Trauma*. 1993;35(1):145–147.

DISCUSSION

Dr. John Como (Cleveland, Ohio): The treatment of traumatic abdominal wall hernias remains a challenge for the acute care surgeon. Although these hernias are rare, surgical therapy can be extremely difficult.

No published guidelines exist regarding the optimal management strategy. Controversies regarding traumatic abdominal wall hernias include, as Dr. Coleman stated: the timing of hernia repair, the type of hernia repair to be performed, and, finally, whether the hernia needs to be repaired at all.

Dr. Coleman and her colleagues from Indiana University have reported a review of their experience with this entity and they try to address these issues. A retrospective review over a 13-year period was performed. Eighty patients were identified, of whom only 29% underwent hernia repair. Forty-four percent underwent an urgent laparotomy or laparoscopy for their injuries.

I have several questions for the authors. Hernia repair is performed in only 29% of patients, as you stated. This seems to be lower than I would have thought.

You mentioned there were no delayed sequelae. How long did you follow these patients up for? What was your follow-up? Was it a clinical follow-up or was it by a CT scan?

Did the size of the defect affect your management strategy? And do you have data on this? The magnitude of the defects was not addressed in the manuscript and I think it's a very important consideration. Are you more likely to repair a defect if it is large or does this only depend on whether there is visceral herniation?

You state that if there is visceral herniation you will initially repair the defect with an absorbable mesh and then evaluate the patient for a delayed repair. What parameters do you use to decide if this repair is needed in a delayed fashion?

Did you use the presence of a certain type of hernia, whether an anterior, flank, or a lumbar hernia, to help you decide if laparotomy is needed? Or do you rely on your CT scan to help you? Shouldn't your CT scan alone help you to determine if a laparotomy is needed in this situation?

You state that 29% of patients who had a laparotomy or laparoscopy had a negative or non-therapeutic operation, excluding the hernia repair. This rate seems to be high, especially after a CT scan had been performed. Do you have any explanation for the high rate of non-therapeutic operations?

And then, finally, did you favor any one type of repair over another, especially for hernias of the flank, which were your most common type of abdominal wall hernia? For example, did you bridge the gap with a mesh or perform some type of component separation? How do you repair the flank hernia in which the muscle is pulled off the iliac wing, for example, and there is no soft tissue left to sew to?

I congratulate the authors on a review of this relatively rare entity, which I think is a very interesting problem. And I look forward to further research on this topic. I also hope that published guidelines will eventually be available regarding this important clinical problem.

Dr. Saman Arbabi (Seattle, Washington): Great study and a very clinically important study. We have 6,000 patients in our center a year and with a lot of pelvic fractures and lumbar hernias and flank hernias. While they may be rare, they are not uncommon. We see them, actually, quite commonly, and so very important clinical question and this study is very clinically useful.

My question is after looking at your data I would say with your algorithm that I would mandate anybody with a ventral hernia to have an operation. In your algorithm you did not have that. If you have 90% associated intraabdominal injury, why not include that as a part of your algorithm that if you have a ventral hernia you would need an immediate or mandatory operation?

Dr. D'Andrea K. Joseph (Hartford, Connecticut): Jamie, thank you for this very interesting paper. A couple of questions: With respect to the hernias, you said that your criteria for non-op was peritoneal signs. I was wondering if you could expand on that a little further because, as you know, that can be a little bit

misleading in most of our patients, not to mention just the presence of blood can be peritonitic.

Also, were there any variations when you looked at your retrospective data with the different types of CT scans as the technology developed?

And, lastly, were the patients who were chosen for non-operative management, did you look at variations in length of stay or vent dependencies or associated infection rates, et cetera, et cetera? Thank you.

Dr. Seth Krosner (San Diego, California): This is wonderful. These are rare. I wonder if you attempted to find the 57 non-ops and find out if they were still okay just beyond their initial clinic visit? I've always worried that some day later in the future these hernias would cause problems…

Dr. James Tyburski (Detroit, Michigan): Excellent study, again. A vexing problem sometimes with these. I'm a little curious how you're sure that they were acute—this is on x-ray—especially inguinal. How do we know we just didn't get it—we're just CT'ing people with inguinal hernias that were in a car accident?

Dr. Ronald Chang (Houston, Texas): What role do you think factors which affect the outcome of elective hernia repair, like smoking status and BMI, should play in the decision making for this problem? Thank you.

Dr. Jamie J. Coleman (Indianapolis, Indiana): Thank you all for these insightful questions. Dr. Como, thank you for agreeing to discuss the paper.

In terms of length of follow-up, it was very variable. Again, this is a retrospective study, so we had some patients who never came back to clinic and we have some patients who we actually had repeated multiple CT scans for a variety of issues. We had follow-up sometimes greater than three years.

It was a great question, too, in terms of 'did the size affect our decision whether or not to operate?' And the short answer is no. Although it would seem that we would be more likely to repair if large—believe it or not, we didn't really have any sort of incidentalomas. Most of these were pretty clinically apparent in terms of soft wall, abdominal wall contusions, et cetera. So that is a great question. However, we did not specifically address that in this study.

This also ties into another question I think Dr. Arbabi mentioned in terms of location. And you raise an excellent point because you are correct. If you have an anterior abdominal wall hernia, the majority of those patients did have an associated intraabdominal injury that required repair. That being said, in terms of working that into the algorithm, we haven't yet at this time due to the overall low numbers. But I agree with you and I do believe that once we can get a multi-center trial going, location will play out in terms of being significant.

Non-therapeutic rate being so high, why is that? You know, I think that really illustrates the difficulty. If you look at the most frequently occurring intraabdominal injuries, a large proportion were small bowel mesentery, and colon mesentery injuries.

Again, I think we struggle with that in terms of a patient who comes in with a mesenteric contusion—you know, which of these patients need to go to the operating room immediately and which ones can undergo serial abdominal observation? I think, again, this being a retrospectively performed study, it depended on the surgeon that was present at the time.

In terms of favor to type of repair, there were no components of separation that were performed acutely. In fact, pretty much everyone tried to undertake an underlay repair, if possible.

This brings up your next question about how to do this when the muscle pulls off the bone? We've all seen those. We actually didn't have any in this study where the technique was used where you can actually drill into the iliac crest and suture through it but that is a technique that has been documented.

Going forward here with other questions, Dr. Joseph, we didn't really see a large variation in length of stay. In fact, patients that were not operated on tended to have overall a lower length of stay.

Dr. Krosner, in terms of the 57 patients, did they have problems, that is an excellent question. You know that was one thing that is nice with having such a large health hospital system. We were able to go through primary care notes for some of the patients—again, not all—and we could not find any symptomology. But you are right and that is one key point to a multi-center trial, that we have long-term follow-up to determine if there was any alteration to activities of daily living.

Dr. Tyburski, that is an excellent question about how were they acute. Again, we struggled with this, sometimes even with anterior abdominal wall hernias. And the short answer is that is why we had a separate attending radiologist review every single possible traumatic abdominal wall hernia. The signs that they looked for were surrounding fat stranding, contusion, those sorts of things that would point to something being acute in terms of edema in the surrounding muscles, et cetera.

Dr. Chang, it is an excellent question and actually BMI was actually one of our initial goals and it was one of my initial thoughts that that would affect the overall incidence or rate of these hernias. Unfortunately, with the retrospectively gathered data we weren't able to statistically say whether BMI mattered. But I do feel that BMI and smoking status are both important in terms of not only development of these hernias but also their repair.

I would like to thank you all, again, for the privilege of the podium. Thank you.