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ORIGINAL ARTICLE

Outcomes of transversus abdominis release in non-elective incisional hernia repair: a retrospective review of the Americas Hernia Society Quality Collaborative (AHSQC)

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Abstract

Purpose Elective repair of large incisional hernias using posterior component separation with transversus abdominis release (TAR) has acceptable wound morbidity and long-term recurrence rates. The outcomes of using this reconstructive technique in the non-elective setting remains unknown. We aim to report 30-day outcomes of TAR in non-elective settings.

Methods All patients undergoing open TAR in non-elective settings were identified within the Americas Hernia Society Quality Collaborative (AHSQC). A retrospective review was conducted and outcomes of interest were 30-day Surgical Site Infections (SSI), Surgical Site Occurrences (SSO), SSOs requiring procedural intervention (SSOPI), medical complications, and unplanned readmissions and reoperations.

Results Fifty-nine patients met inclusion criteria. Mean BMI was 36.6 ± 8.9 kg/m^2 and mean hernia width was 14.4 ± 7.2 cm. Forty (67.8%) were recurrent hernias. Pain (88%) and bowel obstruction (79.7%) were the most frequent indications for surgery. Surgical field was classified as clean in 69.5% of cases, with an 88% use of permanent synthetic mesh and fascial closure achieved in 93.2% of cases. There were 15 (25.4%) total wound events, 8 (13.6%) were SSIs. There were 8 (13.6%) SSOPIs, 6 of which were wound opening, 1 wound debridement, and 1 percutaneous drainage. At least one wound or medical complication was reported for 37% of the patients. There were no mortalities.

Conclusion Not surprisingly, TAR in the non-elective setting is associated with increased wound morbidity requiring procedural interventions and reoperations compared to what has previously been reported for elective cases. The long-term consequences of this wound morbidity with regard to hernia recurrence are as of yet unknown.

Keywords Transversus abdominis release · Emergent · Incisional hernia repair · Emergency

Introduction

There is an increasing need for surgeons to manage large ventral hernias in an emergent setting. Hernia patients presenting emergently tend to be older with comorbidities such as obesity, COPD, smoking and cirrhosis, all of which can increase wound morbidity post-operatively [1–4]. In addition, the presence of incarceration, bowel obstruction, and a septic surgical field can further complicate the clinical scenario. This combination of complex circumstances presents a challenging decision on how to repair this type of hernia. The surgeon must consider bowel viability and gross contamination, as well as make the clinical decision for a formal repair with mesh if needed.

Transversus abdominis release (TAR) is an abdominal wall reconstruction technique with acceptable 30-day wound morbidity consisting of mostly superficial surgical site infections, wound cellulitis, and seromas, which often only required bedside incision and drainage [5]. The TAR has been studied in a variety of different elective settings with similar results [5–13].

Generally, the outcomes of hernia repair in the emergent setting are associated with increased rates of postoperative mortality, reoperation, and readmission [14]. However, outcomes of the TAR in this setting have never been described.

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The complexity of this procedure mandates careful evaluation prior to considering its acceptance in the emergent setting. We aimed to report on the collective experience of surgeons in the Americas Hernia Society Quality Collaborative (AHSQC) utilizing TAR in the emergent setting. We hypothesize that the use of this complex procedure in an emergent setting will result in increased 30-day complications and wound morbidity compared to previously described outcomes in the elective setting.

Methods

After obtaining Institutional Review Board's (IRB) approval, patients were identified and variables were abstracted using the Americas Hernia Society Quality Collaborative (AHSQC). The IRB is an administrative body established under federal regulations to protect the rights, safety, and welfare of research participants and to uphold the ethical principles for human subject protections. The AHSQC data registry is a prospectively maintained, surgeon-entered, point of care continuous quality-improvement registry. At the time of this study, AHSQC had data available from 258 surgeons practicing in a variety of clinical settings, including academic, community, and affiliated hospitals. Details regarding the design, implementation, and data quality assurance of the registry are discussed elsewhere [15].

The study population included patients who underwent open incisional hernia repair between 2013 and 2018 with TAR performed and 30-day follow-up completed, and categorized in the AHSQC as a non-elective repair by the surgeon. Elective surgery is defined in the AHSQC as any surgery that is performed on a patient presenting electively from either home or any normal living situation. Otherwise, the operation is considered emergent. Emergent cases are usually performed within a short interval of time between the diagnosis and onset of symptoms as defined by American College of Surgeons National Surgical Quality Improvement Program (ACS NSQIP) 2014 user guidelines [16]. Notably, the AHSQC does not currently classify procedures as urgent and there is the potential for up or down classification based on these distinctions. Minimally invasive surgeries converted to open were included in the analysis, as were all wound classes. Primary and parastomal hernias were excluded, as we believe they represent a unique case complexity with different outcomes that may bias our results. Figure 1 depicts the inclusion and exclusion criteria for identifying the study population.

A retrospective review of the prospectively collected data was conducted with relevant variables analyzed. These included demographics, patient comorbidities, operative technique, and post-operative outcomes. Data on mesh type, location, and area were missing for one patient. Our main outcomes of interest were 30-day wound events and recurrence rates. Post-operative wound events included Surgical Site Infection (SSI), Surgical Site Occurrence (SSO), and SSO requiring procedural intervention (SSOPI) [17]. SSI was defined according to the Center for Disease Control and Prevention (CDC) classifications as superficial, deep or organ space [18]. Surgical Site Occurrence (SSO) included any SSI, in addition to wound cellulitis, non-healing incisional wound, fascial disruption, skin or soft tissue ischemia, skin or soft tissue necrosis, serous or purulent wound drainage, stitch abscess, seroma, hematoma, infected or exposed mesh, or development of an enterocutaneous fistula. Procedural interventions to be considered SSOPI included wound opening, wound debridement, suture excision, percutaneous drainage, partial mesh removal, and/or complete mesh removal. Indication for surgery is a multiple response question where the surgeon may choose more than one indication for the same patient (example: bowel obstruction and pain). This variable is not exclusive to an emergent operation, and is collected for elective operations similarly. Available responses include: (1) pain, (2) enlarging/interfering with activities, (3) bowel obstruction, (4) fistula, (5) infected mesh, and (6) asymptomatic. Fascial Closure is defined as the complete closure of the anterior fascia. Hernia grade is according to the Modified Ventral Hernia Working Group classification [4]. The follow-up period extended for 30 days for wound events, medical complications, and recurrence. Additionally, wound events and recurrences were reported for a 90-day follow-up period.

Descriptive statistics were used to analyze the data, using exact frequencies, percentages, mean values and standard deviations.

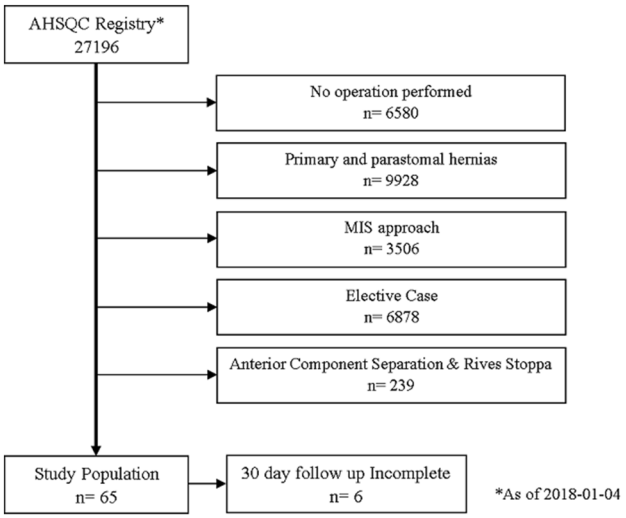

Fig. 1 Inclusion and exclusion criteria

Results

Fifty-nine patients met inclusion criteria. Demographics, hernia characteristics, and operative details are presented in Table 1. Mean BMI was 36.6 ± 8.9 kg/m^2 and mean hernia width was 14.4 ± 7.2 cm. Out of the 59 cases, 40 (67.8%) were recurrent hernias, 24 of which had at least 2 or more previous repairs. The most commonly reported indications for surgery were pain (52; 88%) and bowel obstruction (47; 79.7%). Other indications included an enlarging hernia that is interfering with activities (23; 39%), enterocutaneous fistula (2; 3.4%), and mesh infection (2; 3.4%).

Of the recurrent hernias (40; 67.8%), 5 (12.5%) had a previous component separation, 28 (70%) had a previously placed mesh. Out of those, 7 (25%) were permanent synthetic, 3 (10.7%) were biologic, 9 (32%) were resorbable synthetic meshes, while the rest were unknown. Mesh was resected completely in 21 (75%) cases, partially resected in 6 (21.4%) and left without resection in 1 (3.6%) case.

Forty-one cases (69.5%) were classified as clean wounds. Mesh was placed in the sublay position in the majority of cases (55; 93.2%), using permanent synthetic mesh (52; 88%). Fascial closure was achieved in 55 (93.2%) of cases. Median length of stay was 6.0 [IQR 5–8.75] days.

In total, 19 concomitant procedures were reported, including 1 colostomy take down, 3 small bowel resections, 3 panniculectomies, and 1 hysterectomy. The remaining reported procedures were categorized as "Others". Of the three patients that required a bowel resection, none developed wound complications at 30 day follow-up. However, one patient developed a non-healing incisional wound at 90-day follow-up, and required reoperation.

Table 2 outlines 30-day outcomes. On 30-day follow-up, 15 (25.4%) SSOs were reported, 8 (13.6%) were SSIs, of which four were classified as superficial, three as deep, and one as organ space. The most reported SSI treatment was wound opening (6; 75%). Other needed treatments were wound debridement (1; 12.5%) and percutaneous drainage (1; 12.5%). In addition, 6 (75%) cases required additional IV or oral antibiotics. No mesh removal was required.

Other reported SSOs comprised of 3 (20%) wound cellulitis, and 1 (6.7%) of each seroma, fascial disruption, infected hematoma, wound serous discharge, wound purulent discharge, and non-healing incisional wound. Five (33.3%) required treatment, 3 of which received oral antibiotics,

Table 1 Demographics, hernia characteristics, and operative details

N	59
Age, years (mean ± SD)	57 ± 12
Gender (female)	33 (55.9%)
BMI, kg/m^2 (mean ± SD)	36.6 ± 8.9
Smoking within 1 year	4 (6.8%)
Diabetes mellitus	13 (22%)
Immunosuppressants	4 (6.8%)
Chronic obstructive pulmonary disease	6 (10.2%)
History of abdominal wall SSI	12 (20.3%)
ASA class	
2	9 (15.3%)
3	41 (69.5%)
4	9 (15.3%)
Hernia width, cm (mean ± SD)	14.4 ± 7.2
Hernia area, cm^2 (mean ± SD)	340.4 ± 276.4
Hernia grade	
1	6 (10.2%)
2	35 (59.3%)
3	18 (30.5%)
Recurrent	40 (67.8%)
Number of prior hernia repairs	
1	16 (27.1%)
2	9 (15.3%)
3	6 (10.2%)
4	3 (5.1%)
5+	6 (10.2%)
Mesh area, cm^2 (mean ± SD)	1114 ± 742.7
Mesh location	
Sublay	55 (93.2%)
Inlay	3 (5.1%)
Mesh type	
Permanent synthetic	52 (88.1%)
Biologic	4 (6.8%)
Resorbable synthetic	2 (3.4%)
Wound status	
Clean	41 (69.5%)
Clean-contaminated	8 (13.6%)
Contaminated	7 (11.9%)
Dirty/infected	3 (5.1%)
Fascial closure achieved	55 (93.2%)
Length of stay (median [Q_1–Q_3])	6 [5–8.75]

Table 2 30-Day follow-up

N	59
SSO	15 (25.4%)
SSI	8 (13.6%)
Superficial	4
Deep	3
Organ space	1
SSOPI	8 (13.6%)
Readmission	6 (10.2%)
Reoperation	3 (5.1%)
Any post-op complications	22 (37.3%)

and 2 of which required wound opening. In total, 8 (13.6%) SSOPIs were reported.

On 90-day follow-up, 4 SSOs were reported, 1 of which was an SSI, and 2 required a procedural intervention.

No recurrences were reported on either 30-day follow-up or 90-day follow-up. However, by 30-day follow-up, there were 6 (10.2%) readmissions, 1 of which was for major wound complications, and 2 for gastrointestinal complications. Readmission reasons are not a required field within the AHSQC, and the remaining three readmissions reasons were not reported in the database. In addition, there were 3 (5.1%) reoperations, 2 of which were for major wound complications, and one for unrelated intra-abdominal pathology.

Table 3 outlines other medical outcomes.

Discussion

Ours is the first study to describe the outcomes of TAR in the emergent setting. We found that patients undergoing TAR in the emergent setting have a high rate of wound morbidity, with more than half of the events requiring a procedural intervention, as well as readmission and reoperation. While there was no mortality, over one-third of patients had at least one wound or medical complication. Given the substantial wound morbidity found here, the decision to offer TAR in the emergent setting should be undertaken cautiously.

Emergent ventral hernias have a spectrum of clinical presentations with specific challenges for each individual case. After salvaging the bowel and resolving the acute presentation, the surgeon must then decide on how to best handle the defect and the advisability of performing a definitive reconstruction. Other authors have found that emergent hernia repair results in worse outcomes compared to an elective repair, with an increased rate of reoperation, readmission, and an overall higher mortality [1, 14]. The optimal repair of an emergently presenting hernia remains an active area of research and debate. A recently published expert consensus paper suggests that the priority in emergently presenting hernias is resolving the acute problem, and if proceeding with a formal repair, caution and discretion should be taken after evaluating the presence of bowel obstruction, bowel edema, and patient comorbidities. This recommendation was given based on Grade D evidence [19]. Ultimately, there is very little current literature to guide decision-making regarding specific operative management of the complex hernia in the acute setting.

Consequently, the surgeon has a myriad of different approaches that can be performed; a primary repair or a bridged repair with resorbable mesh avoids the possible complications of an emergent definitive repair. However, this approach guarantees a recurrent hernia, and burdens the patient with an additional surgery. If a definitive repair is deemed safe by the hernia surgeon, both an anterior and posterior component separation are possible approaches. This will depend on surgeon preference and level of expertise. We would suggest that such extensive operation in the emergency setting only be undertaken by surgeons familiar with abdominal wall anatomy and experienced in complex abdominal wall reconstruction. Nevertheless, raising subcutaneous flaps for onlay repairs has been found to increase wound morbidity [20], and is generally not preferred by the authors of this manuscript for complex incisional hernias. In the setting where the contours of the hernia sac have already dissected through the subcutaneous layer and created a preformed plane, an anterior component separation with onlay mesh may be acceptable. The posterior component separation has improved short- and long-term outcomes [5]. If performed successfully with minimal resulting morbidity due to the emergent nature, a definitive repair in this setting may be beneficial. Both the acute emergent presentation and the chronic hernia would be resolved in one surgery and this will incur decreased costs for additional hospital admissions, shorter medical leaves, and will avoid anesthetic complication in high-risk populations. Conversely, the TAR is an extensive abdominal wall reconstruction surgery, and accessing the preperitoneal plane under suboptimal conditions may potentially harm the patient and hinder a future dissection into the same plane if a complication were to occur due to the nature of an emergent presentation.

Mesh selection in this scenario is also controversial. The use of synthetic mesh has previously been questioned due to risk of mesh infection in contaminated surgical fields, which may be more prevalent due to the presence of bowel obstruction in the emergent setting. Although the Ventral Hernia Working Group recommends the use of biologic mesh in high-risk wounds [21], biologic mesh was only used in 4 out of the 18 contaminated and dirty wound classes in our study. On the other hand, a study evaluating the outcomes of synthetic mesh in 100 cases of contaminated wound classes found favorable surgical site infection and recurrence rates [22]. There remains a lack of high-quality data on the optimal mesh selection in these wound classes. Our group is currently conducting a randomized control trial assessing the use of synthetic vs biologic mesh in contaminated wound

Table 3 Post-operative medical complication

N	59
Pain requiring intervention	1 (1.7%)
Pulmonary embolism	3 (5.1%)
Deep vein thrombosis (DVT)	1 (1.7%)
Urinary tract infection (UTI)	1 (1.7%)
Acute renal failure	2 (3.4%)
Pneumonia	1 (1.7%)

classes, with hopes that it will provide more meaningful conclusions (ClinicalTrials.gov Identifier: NCT02451176).

Our analysis shows an incidence of wound morbidity with the emergent use of TAR comprising of 25.4% SSOs and 13.6% SSIs. This is comparable with findings in current research on ventral hernia repair in an emergent setting [14]. Haskins et al. studied the NSQIP database for emergent ventral hernia repair in wound classes II–IV. Their data for repairs using mesh show a 20.29% total wound morbidity, 17.29% were SSIs [23]. Zafar et al. [24] report similar wound rates with an infection rate of 31% in a group of emergent incisional hernia patients repaired with onlay technique. Only one patient required a mesh removal.

In the elective setting, the TAR has consistently shown favorable outcomes [10]. In a large series of complex abdominal wall reconstruction with posterior component separation reporting on 428 patients with a mean follow-up of 31.5 months, 18.7% developed SSOs, 9.1% were SSIs. Only 7.3% required a procedural intervention, with 2.8% of those by bedside incision, drainage, and packing. Wound morbidity after elective TAR has been found to be significantly less than anterior component separation [20], and is mainly comprised of minor superficial infection needing only antibiotics. If deeper infection occurs, management is often incision, and drainage, and at most, wound debridement. Mesh is not usually removed [5, 6, 10, 20]. Most of the SSIs in our study required wound opening in addition to antibiotics. The rate of surgical intervention due to wound morbidity was found to be higher than an elective TAR, with 13.6% requiring procedural intervention, which is twice that reported in the aforementioned study. Major wound complications were significant enough to result in one case of readmission and two reoperations. These findings aligned with our initial hypothesis. While it is likely that there are some inherent differences between the elective and emergent groups being compared in different trials, it is important to recognize that the overall wound morbidity is almost twice as much in the emergent setting.

The increased incidence of wound events may be due to either the wound class or bowel pathology and need for resection, in addition to a septic surgical field. Another contribution could be patient-related risk factors. Obesity was prevalent in our patient population, with a mean BMI of 36.6 ± 8.9 kg/m^2. Additionally, 12 (20.3%) patients had a previous history of surgical site infection, with 4 (6.8%) presenting with either a fistula or an infected mesh. Four (6.8%) were active smokers within 1 year at the time of surgery and 13 (22%) were diabetics. These characteristics have been shown to increase wound morbidity [4]. However, these characteristics are similar to previous cohorts described in elective settings. In the 2016 paper by Novitsky et al. mean BMI was 34.4 ± 13 kg/m^2, 21% were diabetics, and 7% were smokers within 3 months of surgery. Our average defect width was 14.4 ± 7.2 cm, which is also similar to the mean defect width of 15.2 cm in Novitsky's 2016 paper. Our mean BMI and defect width fall within the spectrum where the TAR is expected to perform well, if not superior to other techniques. Additionally, only three cases required bowel resection, while the majority of the cases were clean. The presentation of our cohort most closely resembles an elective setting and may indicate that surgeons are more willing to perform a TAR only when the bowel was found to be viable, the surgical field is not contaminated, and the hernia width requires this repair. However, we cannot conclude this with certainty. Despite the similar comorbidities and surgical details, there was still a twofold increase of wound morbidity in our cohort. While the long-term consequences of this outcome are unknown, it is still a concerning finding which should be taken into account when determining the operative plan. Of note, other surgical procedures have been found to increase morbidity when performed acutely, despite similar demographics in the elective setting, or after risk adjustments. A National Surgical Quality Improvement Program (NSQIP) database study comparing outcomes of patients who underwent colectomy for diverticulitis by the type of admission (emergent vs urgent vs elective) found that patients undergoing emergent operations have twicefold increased odds for overall morbidity [25]. Similarly, using the Swiss Association of Laparoscopic and Thoracoscopic Surgery and adjusting for relevant variables, Giger et al. found that an emergent cholecystectomy independently increased odds for post-operative local and systemic complications [26].

The main advantage of the TAR is in its low recurrence rates, with rates as low as 3.7% after a mean follow-up of 31.5 months [5]. While no recurrences developed in our 90-day follow-up period, longer follow-up is needed to draw meaningful conclusions.

Our comparisons to Novitsky's paper should be considered with caution, as papers reporting on TAR are usually by referral centers with robust experience performing TARs in major volumes. On the other hand, we report the experience of 59 surgeons, with 44 having academic affiliation, and 11 either in private practice or in private practice with academic affiliation. Their individual volume and expertise in TAR were not analyzed and therefore we are not able to comment on their collective experience.

Limitations to our study include lack of long-term follow-up, small sample size, and lack of a comparison group that did not receive a TAR. Ideally, to provide a more comprehensive analysis, further studies are needed to compare our cohort to staged hernia repairs, where the acute problem is resolved and a delayed elective abdominal wall reconstruction is offered after optimization. Additionally, our study is retrospective in nature, and therefore we present a selective group of patients where a surgeon assessed the presenting

scenario and elected to perform this complex procedure only when they perceived its benefit to outweigh the risk. These findings may not be applicable to all emergent scenarios, as the level of contamination and concomitant procedures may significantly affect the outcome. Moreover, our findings may be confounded by an array of unmeasured and uncontrolled variables, some of which may be specific to the unpredictable emergent setting. Some examples include time of day the operation is performed, the availability of a hernia specialist, surgeon preference, the length of the operative procedure, and the degree of illness in the presenting patient. Finally, this is a large registry-based study, with certain limitations regarding data input; there were three inlay meshes reported in this cohort, which is unusual for a TAR repair. We cannot explain this finding and have attributed it to potential error during data entry by the surgeon. Moreover, equating the indications for surgery to the classification of an emergent operation in the AHSQC is limited. The potential for urgent surgeries to be classified as emergent surgeries cannot be distinguished in our dataset and our analysis should be interpreted with caution when drawing firm conclusions.

Conclusion

Although performing TAR in an emergent setting is feasible, it is associated with increased wound morbidity requiring procedural interventions and reoperations in comparison to an elective setting. While most of the patients in our cohort were able to resolve their wound morbidity without further operation, the doubling of overall wound morbidity as compared to prior reports on elective cases suggests that surgeons should proceed with caution when considering performing TAR in the emergent setting. Further study is needed to elucidate whether primary or temporary bridged fascial closure is preferable to TAR in a similar group of patients.

Compliance with ethical standards

Conflict of interest Author ASP reports grants from Intuitive Surgical, Inc., personal fees from MedTronic, personal fees from Bard Davol, outside the submitted work. Author MJR reports receiving salary support for role as medical director of nonprofit AHSQC, grants from Intuitive Surgical Inc., Pacira, and Miromatrix, outside the submitted work. Author LT reports grants from Americas Hernia Society Quality Collaborative (AHSQC), outside the submitted work. Author MO reports that the AHSQC has contracted with Vanderbilt University Department of Biostatistics to provide support for AHSQC projects. The work provided for this publication was performed under the umbrella of the Vanderbilt Biostatistics and AHSQC collaboration plan from Vanderbilt University Medical Center, during the conduct of the study. Authors HA, DMK, CCP, SR declare that they have no conflict of interest.

Ethical approval This study did not need approval from the local ethical committee.

Human and animal rights This study does not contain any studies with participants or animals performed by any of the authors.

Informed consent For this type of study, formal consent was not required.

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