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ORIGINAL ARTICLE

The influence of a multidisciplinary team meeting and prehabilitation on complex abdominal wall hernia repair outcomes

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Abstract

Purpose Surgical site occurrences after transversus abdominis release in ventral hernia repair are still reported up to 15%. Evidence is rising that preoperative improvement of risk factors might contribute to optimal patient recovery. A reduction of complication rates up to 40% has been reported. The aim of this study was to determine whether prehabilitation has a favorable effect on the risk on wound and medical complications as well as on length of stay.

Methods A retrospective cohort study was performed in a tertiary referral center for abdominal wall surgery. All patients undergoing ventral hernia repair discussed at multidisciplinary team (MDT) meetings between 2015 and 2019 were included. Patients referred for a preconditioning program by the MDT were compared to patients who were deemed fit for operative repair by the MDT, without such a program. Endpoints were patients, hernia, and procedure characteristics as well as length of hospital stay, wound and general complications.

Results A total of 259 patients were included of which 126 received a preconditioning program. Baseline characteristics between the two groups were statistically significantly different as the prehabilitated group had higher median BMI (28 vs 30, $p < 0.001$), higher HbA1c (41 vs 48, $p = 0.014$), more smokers (4% vs 25%, $p < 0.001$) and higher HPW classes due to more patient factors (14% vs 48%, $p < 0.001$). There were no significant differences in intra-operative and postoperative outcome measures.

Conclusions This study showed prehabilitation facilitates patients with relevant comorbidities achieving the same results as patients without those risk factors. The indication of a preconditioning program might be effective at the discretion of an MDT meeting. Further research could focus on the extent of such program to assess its value.

Keywords Complex abdominal wall surgery · Prehabilitation · Multidisciplinary team meetings · Hernia · Postoperative outcomes · High-risk patients

Introduction

Incisional hernias following any kind of abdominal surgery remain an unremitting surgical challenge. This is most applicable in patients with large size (> 10 cm) hernias, recurrent hernias and hernias with a compromised surgical field, like an entero-atmospheric fistulas or an infected prosthetic mesh [1]. Recent studies report up to 33% of surgical site occurrences (SSO) after repair with open anterior component separation techniques of these complex abdominal wall hernias [2–5]. After posterior component separation techniques with a transversus abdominis release (TAR), SSOs occur still in up to 15% of patients [6].

Previous studies have demonstrated that SSOs occur mainly in patients having a high-risk characteristic at the time of surgery [7–9]. Numerous studies have unambiguously reported that preoperative smoking, obesity, or a low physical activity level influence incisional hernia repair negatively, in terms of SSO and recurrence [10–15]. Breaking the "vicious circle" of subsequential hernia repairs in a single patient, can be achieved by rigorously addressing these risk factors [3, 13]. Evidence is rising that preoperative modification of any of these risk factors, known as prehabilitation, increases patient recovery and deminishes complications [3, 16–21].

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In 2018, Liang et al. completed the first randomized controlled trial on prehabilitation in ventral hernia repair. This study demonstrated that prehabilitated patients were more likely to be without complications after one month compared to non-prehabilitated patients (70% vs 48%, $p = 0.015$) [22]. Renshaw et al. described that patients prosecuting greater exercise frequency before surgery proved decreased risk of complications and readmission after ventral hernia repair [23, 24]. Delaying surgery and optimizing or improving the aforementioned risk factors may reduce complication rates by as much as 40% [15, 23, 25–27].

These results emphasize the potential effect of prehabilitation. It has even been suggested that prehabilitation of high-risk patients is as important as, if not more important than, the surgical technique itself [17, 28, 29].

The aim of this study was to evaluate whether prehabilitation of complex hernia patients with modifiable risk factors has a favorable effect on outcome in patients undergoing complex abdominal wall repair.

Methods

This retrospective cohort study was performed in a referral center for complex abdominal wall surgery. All consecutive patients surgically treated for complex abdominal wall hernias between December 2015 and December 2019 were included. Patients undergoing laparoscopic repair were excluded.

Abdominal wall hernias were defined complex if there was at least one of the following factors present: width > 10 cm, parastomal hernia, infected mesh, presence of a stoma, fistula or abscess, or loss of domain greater than 20% [30, 39]. Patients with at least one modifiable risk factor like body mass index (BMI) > 30 kg/m^2, active nicotine abuses, diabetes mellitus (with HbA1c > 65), COPD (> Gold I), usage of immunosuppressive medication or MET score < 4, were also considered complex hernia patients.

All patients were discussed at least once in a multidisciplinary team meeting (MDT) by a surgeon, pulmonologist, cardiologist, anesthesiologist, and physiotherapist. Assays such as a CT-scan, an EKG, blood tests for hemoglobin, HbA1c and albumin were prosecuted beforehand. Hernias were anatomically graded by the EHS classification and HPW classification [11, 31].

During the MDT, a color code is allocated to each patient. Patients without any risk factors are allocated green and considered fit for surgery. Patients with at least one modifiable risk factor are allocated orange, and are eligible for surgery, only after successful prehabilitation. Patients with too many (or unmodifiable) risk factors are allocated red.

All orange patients were offered a preconditioning program, which was covered by patients' insurance. Such a program compromised weight loss counseling, smoking cessation counseling, glycemic control by a specialized nurse, pulmonary preparation, and physiotherapy (Table 1). After prehabilitation, the patient was discussed again in the MDT. If prehabilitation was deemed successful by the MDT, the allocated color code shifted from orange to green.

Outcome after complex hernia repair was compared between two consecutive patient cohorts: green patients (without risk factors nor prehabilitation) versus orange patients (after successful prehabilitation). Endpoints were differences in baseline and intra-operative characteristics, and postoperative outcome (90-day complications such as SSO, SSI, SSE, pulmonary embolism, pneumonia, ileus/gastroparesis, or other systemic complications; length of hospital stay and readmission and reoperation).

Table 1 Modifiable risk factors and prehabilitation interventions

Risk factor	Defined by	Intervention	Achieved if
Smoking	≥ 1 cigarette/day	Nicotine substitute	Quitted smoking
		Quit smoking programme	≥ 4 weeks prior to surgery
Morbid obesity	BMI ≥ 35	Dietician	BMI ≤ 35 or
		Physical activity	≤ 5% weight loss
		Bariatric surgery	
Physical condition	MET score ≤ 4	Physiotherapist	MET score > 4
		Sports physician	
Diabetes, glycemic levels	HbA1c ≥ 65	Diabetes nurse	HbA1c < 65
		Medication optimalization	
Pulmonary condition	COPD II-IV	Consultation of pulmonologist	Optimal pulmonal condition
	Other obstructive pulmonary diseases	Medication alteration	consented by pulmonologist
Cardial condition	EKG abnormalities	Consultation of cardiologist	Optimal cardial condition
		Medication alteration	consented by cardiologist

Data were retrieved from a database in which every patient with a complex abdominal wall defect was registered prospectively since 2014. Differences between demographic groups of categorical data were tested using the Chi-squared or Fisher's exact test. The summary statistic was the *p* value. The patient demographics were judged and continuous variables such as age, BMI and MET score were kept continuous, to prevent loss of data associated with categorizing. These variables were analyzed using an independent unpaired *T* test. A *p* value < 0.05 was considered statistically significant.

Results

A total of 418 consecutive patients were discussed in the 4-year study period (Fig. 1). The MDT allocated 230 patients (55%) orange, 144 patients (34%) green and 44 patients (11%) red. Almost half (45%) of all primarily coded orange patients, did eventually not undergo surgery. Being unable to adequately finish prehabilitation was the most important reason. Other reasons to refrain from surgery were a concomitant disease requiring therapy, decrease of hernia-related complaints as a result of prehabilitation, or choosing another hospital. Eventually, 259 operated patients were included in this study: 133 primary green patients (group I), and 126 primarily orange patients after successful prehabilitation (group II).

Baseline characteristics between group I and II were different in BMI (median 28 versus 30, $p < 0.001$), HbA1c (mean 41 versus 48, $p = 0.014$) and the rate of active smokers (4% versus 25%, $p < 0.001$) (Table 2). After prehabilitation of orange patients, both BMI and nicotine abuse significantly decreased (Table 3). No differences in intra-operative conditions, like the rate of component separation techniques, were demonstrated (Table 4).

No significant differences in short-term complications were noted between the groups in the convalescence period (Table 5). The length of hospital stay was comparable between the groups: 6 days ($p = 0.908$).

Discussion

This study demonstrated that outcome of complex ventral hernia repair in patients who underwent preoperative prehabilitation of modifiable risk factors was similar to patients without those risk factors. This finding is in line with studies reporting that prehabilitation might facilitate amelioration of the preoperative condition of patients undergoing complex abdominal wall repair [15, 17, 23, 27]. A recent systematic review performed by Jensen also concluded that smoking cessation and weight loss for obese patients led to reduced complication risks, as was seen in this study [28].

The conclusion of this study is based on patients operated before the COVID-19 pandemic, because during the pandemic patients were not able to prehabilitate accurately under supervision, nor could bariatric surgery be performed to correct morbid obesity, before definitive hernia repair. The conclusion is limited by the retrospective nature of this study and the fact that outcome of prehabilitated patients with risk factors could not be compared to non-prehabilitated patients with risk factors. In our cohort, all patients with modifiable risk factors were treated with prehabilitation.

The multidisciplinary team meeting provides comprehensive, patient-centered care and acts as a platform to discuss the optimal treatment strategy for a patient. Implementing

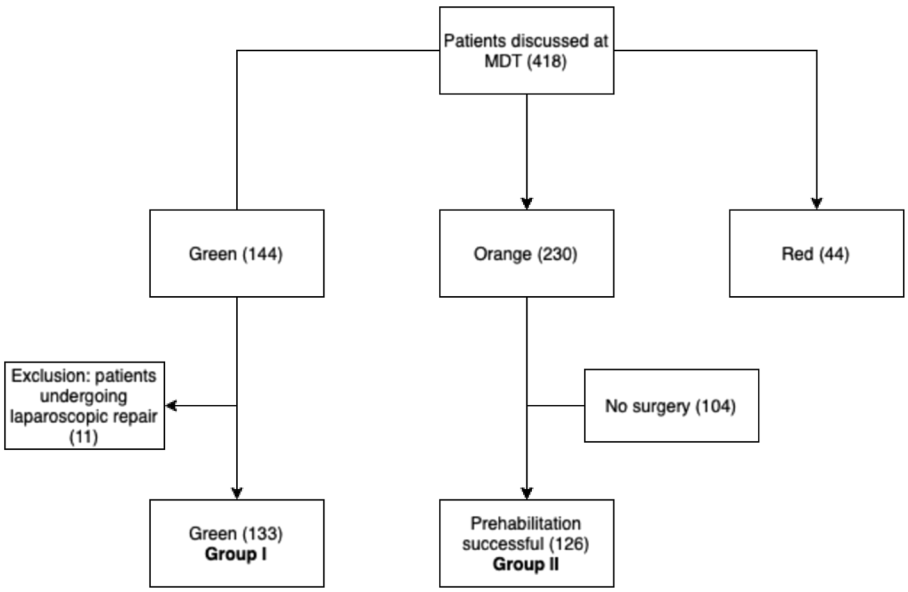

Fig. 1 Patient inclusions flowchart

Table 2 Preoperative characteristics of patients that underwent complex abdominal wall surgery

	Total	I (no risk factors)		II (prehabilitated patients)	*p*
n	259	133		126	
Hernia factors					
Width < 10 cm (*n*,%)	137 (53)	77 (58)	60 (48)		0.254
Width 10–20 cm (*n*,%)	109 (42)	50 (38)	59 (47)		
Width > 20 cm (*n*,%)	13 (5)	6 (5)	7 (6)		
Recurrent hernia (*n*,%)	79 (31)	38 (29)	41 (33)		0.488
Patient factors					
Age (median, IQR)	128 (54–68)	63 (54–68)	65 (57–72)		0.052
Smoking (*n*,%)	37 (14)	5 (4)	32 (25)		**< 0.001**
BMI (median, IQR)	58 (25–29.5)	28 (25–29.5)	30 (27–33)		**< 0.001**
BMI > 30 (*n*,%)	87 (34)	22 (17)	65 (52)		**< 0.001**
BMI > 35 (*n*,%)	17 (7)	3 (34)	14 (11)		**0.004**
Diabetes (*n*,%)	29 (11)	10 (8)	19 (15)		0.054
HbA1c (median, IQR)	89 (34–54)	41 (34–54)	48 (42–57)		**0.014**
HbA1c > 65 (*n*,%)	3 (34)	0 (0)	3 (34)		0.094
Immunosuppressives (*n*,%)	14 (5)	4 (3)	10 (8)		0.079
COPD (II-IV) (*n*,%)	42 (16)	17 (13)	25 (20)		0.123
Pulmonary preparation (*n*,%)	62 (24)	24 (18)	38 (30)		**0.022**
MET score (median, IQR)	13 (6–8)	7 (6–8)	6 (5–7)		**0.004**
MET score < 4 (*n*,%)	20 (8)	8 (6)	12 (10)		0.290
cP 0 (*n*,%)	179 (69)	114 (86)	65 (52)		**< 0.001**
cP 1 (*n*,%)	80 (31)	19 (14)	61 (48)		
Wound factors					
cW 0 (*n*,%)	212 (82)	111 (83)	101 (80)		0.491
cW 1 (*n*,%)	47 (18)	22 (17)	25 (20)		
Previous wound infection (*n*,%)	94 (36)	44 (33)	50 (40)		0.270
HPW Classification					
HPW 1 (*n*,%)	80 (31)	54 (41)	26 (21)		**0.003**
HPW 2 (*n*,%)	129 (50)	54 (41)	75 (60)		
HPW 3 (*n*,%)	42 (16)	22 (17)	20 (16)		
HPW 4 (*n*,%)	8 (3)	3 (34)		5 (4)	

BMI body mass index (kg/m^2), *COPD* chronic obstructive pulmonary disease, *MET* metabolic equivalents, *cW 1* contaminated field, *HPW* hernia, patient, wound

cP1: at least one patient risk factor present (BMI > 35, active smoker, use of immunosuppressives, diabetes)

cW1: CDC2-4 wound classifications (clean-contaminated, dirty-contaminated or dirty surgical field)

Statistically significant values are shown in bold

this multidisciplinary team meeting to a complex hernia care pathway was promoted by several authors and even demonstrated improved outcomes after complex abdominal wall reconstruction [32–34]. Improved outcome may be a consequence of optimized patient selection by the MDT.

In our experience, the process of optimizing patient selection in the MDT passes a learning curve [8, 35]. Firstly, it was noticed that outcome could be improved by sticking tighter to the predetermined prehabilitation goals. In particular, the requirement to have a BMI < 30, and completely refrain from smoking, became, over time, an absolute prerequisite to be eligible for hernia repair. Improved adherence to the prehabilitation protocol, may have contributed to the good outcome in the high-risk patients. Secondly, the decision not to operate a complex hernia patient with (unmodifiable) risk factors is difficult. Formerly, these decisions were made by a surgeon in 'splendid isolation' [33]. By sharing in a team approach to care, these decisions

Table 3 Effect of prehabilitation in patients with modifiable risk factors in 126 patients

$n=126$	I Before	II After	p
Patient factors			
Smoking (n,%)	32 (25)	16 (13)	**0.0103**
BMI (median, IQR)	30 (27–33)	29 (27–31)	**< 0.001**
BMI > 30 (n,%)	65 (52)	48 (38)	**0.0312**
BMI > 35 (n,%)	14 (11)	7 (6)	0.1106
Diabetes (n,%)	19 (15)	19 (15)	1.000
HbA1c (median, IQR)	48 (34–54)	47.5 (42–55)	0.065
HbA1c > 65 (n,%)	3 (1)	1 (1)	0.3134
Immunosuppressives (n,%)*	10 (8)	5 (4)	0.1831
MET score < 4 (n,%)	12 (10)	5 (4)	0.0787

*Patients who did not alter their regular immunosuppressives schedule were considered still using immunosuppressives

Statistically significant values are shown in bold

became better substantiated. Subsequential analysis of these decisions improved the decision-making process in the MDT over time. Thirdly, increased attention for other risk factors developed [36]. Involving a geriatric physician in the multidisciplinary team meetings aids in addressing age-related risk factors [37]. Likewise, involving a psychiatrist, psychologist, or mental caretaker may decrease anxiety, medication usage, withdrawal symptoms or delirium in patient with mental diseases [38]. Finally, positive patient feedback, in combination with the results of this study, led to the continuation of the prehabilitation process. Noticeably, in some patients, increased exercises, a lower weight or stopped nicotine abuse (no more coughing) led to disappearance of hernia-related symptoms, which even dissolved their quest for repair [39].

To analyze the effects of prehabilitation, comparing centers that use a strict prehabilitation protocol, versus centers that do not use such a protocol, may shine light on this topic. However, as suggested in this study, the positive relation between prehabilitation and outcome may also be strongly influenced by the presence of an MDT with optimal patient selection. A lot of uncovered ground in this area of surgery is present, and further extensive research should be conducted to establish the best care pathway for this patient population.

While balancing patients' demands and expectations, against the risk of surgery, the most difficult part of prehabilitation proves to be motivating and persuading the patient and preventing the surgeon from instant surgery. Prehabilitation is a promising tool to improve outcome in complex hernia patients. "First treat the patient, then treat the hernia".

Conclusion

Prehabilitation of patients with modifiable risk factors may downstage complex hernia patients from high-risk to low-risk patients. Prehabilitation may have a favorable effect on outcome and the indication of such a preconditioning program might be at the discretion of a multidisciplinary team meeting. Future research could focus on the extent of such program to assess its value.

Table 4 Perioperative characteristics of patients that underwent complex abdominal wall surgery

	Total	I (no risk factors)	II (prehabilitated patients)	p
n	259	133	126	
Surgery time (mean, minutes)	135.5 (90–168)	132.9 (87–164)	138.2 (92.5–173)	0.244
Type of myofascial release				
Retrorectus (n, %)	132 (51)	71 (53)	61 (48)	0.257
Unilateral TAR (n, %)	18 (7)	6 (5)	12 (10)	
Bilateral TAR (n, %)	48 (19)	21 (16)	27 (21)	
eCST (n, %)	56 (22)	33 (25)	23 (18)	
Ramirez (n, %)	5 (34)	2 (34)	3 (34)	
Contamination of the surgical field (n, %)	39 (15)	22 (17)	17 (13)	0.493
Infected mesh (n,%)	21 (8)	11 (8)	10 (8)	0.921

TAR transversus abdominis release, *eCST* endoscopic component separation technique

Table 5 Postoperative outcome measures

	Total	I (no risk factors)	II (prehabilitated patients)	*p*
n	259	133	126	
SSO (*n*,%)	87 (34)	43 (32)	44 (35)	0.659
Seroma I–II (*n*,%)	22 (8)	9 (7)	13 (10)	0.306
Seroma III–IV (*n*,%)	19 (7)	10 (8)	9 (7)	0.908
Hematoma I–II (*n*,%)	28 (11)	12 (9)	16 (13)	0.341
Hematoma III–IV (*n*,%)	8 (3)	3 (2)	5 (4)	0.426
SSE	18 (7)	6 (5)	12 (10)	0.113
SSI	31 (12)	14 (11)	17 (13)	0.462
SSOPI	13 (5)	6 (5)	7 (6)	0.700
Systemic complications				
0 (*n*,%)	165 (64)	81 (61)	84 (67)	0.190
1 (*n*,%)	60 (23)	31 (23)	29 (23)	
2 (*n*,%)	17 (7)	13 (10)	4 (3)	
> 2 (*n*,%)	17 (7)	8 (6)	9 (7)	
Airway infection (*n*,%)	54 (21)	28 (21)	26 (21)	0.934
Pulmonary embolism (*n*,%)	6 (34)	5 (4)	1 (34)	0.113
Gastrointestinal (*n*,%)	24 (9)	10 (8)	14 (11)	0.319
Cardial (*n*,%)	10 (4)	7 (5)	3 (34)	0.229
Other complications (*n*,%)	45 (17)	24 (18)	21 (17)	0.769
Mortality (*n*,%)	4 (2)	3 (2)	1 (1)	0.340
Length of stay (median, QR)	6 (5–8)	6 (5–8)	6 (5–8)	0.401
Admission > 7 days (*n*,%)	57 (22)	27 (20)	30 (24)	0.496
Reoperation (*n*,%)	14 (5)	4 (3)	10 (8)	0.079
Readmission (*n*,%)	12 (5)	4 (3)	8 (6)	0.201

SSO surgical site occurrence, *seroma/hematoma I–II* no clinical significance, *seroma/hematoma III–IV* clinical significance- needing intervention, *SSE* surgical site event, *SSI* surgical site infection, *SSOPI* surgical site occurrence requiring procedural interventions

Declarations

Conflict of interest There is no conflict of interest from any of the authors.

Ethical approval Not necessary given the retrospective nature of the study. No changes were made in the original care pathway for patients.

Human and animal rights The authors state that this research was conducted in accordance with the Helsinki Declaration as revised in 2008.

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