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ORIGINAL SCIENTIFIC REPORT

Chronic Pain, Quality of Life and Functional Impairment After Emergency Laparotomy

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Abstract

Background Emergency laparotomy is a high-risk procedure with increased morbidity and mortality rates. The long-term outcomes are poorly investigated.The aim was to describe the frequency of chronic postsurgical pain (CPSP), pain-related functional impairment, to evaluate the gastrointestinal quality of life (QoL) and identify risk factors for CPSP after emergency laparotomy.

Method A questionnaire study was conducted from Copenhagen University Hospital Herlev. Population area: 435.000. Patients undergoing emergency midline laparotomy from May 2009–May 2013 and June 2014–November 2015 were included. The survey consisted of five parts exploring the extent of acute and chronic postsurgical pain. Pain-related functional impairment and quality of life were measured using the activity assessment scale and the gastrointestinal quality of life questionnaire, respectively. Primary outcomes were rates of CPSP and pain-related functional impairment. Gastrointestinal QoL was compared between patients with or without CPSP. Multivariate regression analysis was performed to estimate risk factors for CPSP.

Results The primary emergency laparotomy population consisted of 1573 patients. A total of 605 patients were eligible for inclusion, and 440 patients completed the survey. Response rate: 73%. Median age was 69 years (range 18–95), 56.4% female. Median follow-up was 60 months (IQR 47). 19% (85/440) experienced CPSP and had low gastrointestinal QoL. We identified APSP OR 5.0 95%CI (2.4–10.5), $p < 0.01$ and age < 60 OR 2.1 95%CI (1.2–3.8), $p = 0.01$ as independent risk factors for CPSP. 45% (199/440) of all patients experienced moderate–severe functional impairment.

Conclusion CPSP (19%) and low gastrointestinal QoL were common after emergency laparotomy and almost every second patient had moderate–severe functional impairment on long-term follow-up.

Introduction

Long-term follow-up regarding chronic postsurgical pain (CPSP) and poorer quality of life (QoL) after elective gastrointestinal procedures has been reported with a prevalence of 18% up to four years after laparotomy [1]. There are few studies concerning long-term follow-up after emergency laparotomy, but similar rates of one in five patients developing CPSP and poorer QoL have been described [2–4]. Some of the risk factors for CPSP are acute postoperative pain, female sex and young age [3]. A

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systematic review from 2014 with 57,058 patients [5] found significantly negative effects of surgical adverse events on QoL related to different gastrointestinal procedures, but contained only one study on emergency laparotomy. The strongest predictor for lower QoL was length of hospitalization suggesting that frailty, comorbidity and postsurgical complications all together affect physical health and may lead to the loss of functional capacity especially in the elderly patients. In various elective gastrointestinal surgeries, functional impairment was described in 24% on short-term follow-up [6] and protracted in up to 6 months past the surgery [7]. Emergency laparotomy is a high-risk procedure with serious morbidity and complications in up to 50% of the patients [8–11]. Despite the high risk, little is known about the long-term outcomes.

The aim of this study was to describe the frequency of CPSP, pain-related functional impairment and secondly to evaluate the gastrointestinal QoL and to identify risk factors for CPSP after emergency laparotomy.

Materials and methods

This questionnaire study was conducted at Copenhagen University Hospital Herlev, a 949-bed university teaching hospital, serving a population area of 435,000. All patients undergoing any gastrointestinal emergency midline laparotomy from May 2009 to May 2013 and June 2014 to November 2015 were included. There was an interrupted time course in this trial, since our patient population was a follow-up study on a prior study [12], where a prospective interventional study on standardized closure of the abdominal wall was conducted (year 2014–15). The rate of fascial dehiscence was evaluated and risk factors for dehiscence and mortality were reported and outcomes compared to a historic cohort (year 2009–13). Exclusion criteria were: death, age below 18, cognitive impairment and non-Danish speaking patients. Patients who had undergone any laparotomy in the same incision since the primary operation were also excluded to make sure any interference due to another procedure was ruled out.

Approval of data collection was obtained from the Danish Data Protection Agency HGH-2016-030 I-suite: 04477 and no ethical approval was needed from the ethics committee according to Danish law, due to the aim and methodology of the study.

Data were collected from journal review. Preoperative data included demographics, American Society of Anesthesiologists (ASA) score, body mass index (BMI), alcohol and smoking habits and preexisting comorbidities. Performance score was defined according to Zubroed/WHO classification. Intraoperative data consisted of type of surgery performed and degree of intraabdominal contamination (clean-contaminated or contaminated-dirty) [13]. We chose to categorize the underlying pathologies according to the degree of peritonitis as an indirect variable expressing the severity of abdominal sepsis and the underlying diseases. The eligible study population was contacted by telephone to explore whether the patients would participate in the survey, and a questionnaire was then sent by regular mail. Patients who did not answer the questionnaire were identified and once again contacted, and the survey completed as a telephone interview. The questionnaire was validated in a prior study [14].

The survey consisted of different parts:

(1) The initial part explored abdominal pain and was evaluated in respect to frequency, intensity, the influence of daily living and the use of analgesics. The pain intensity was evaluated by the numerical rating scale (NRS) (mild = 1–3, moderate = 4–6 and severe = 7–10) in regard to the average and worst experienced pain. Acute postsurgical pain (APSP) was defined as pain within 24 h after the surgery. CPSP was defined as abdominal pain within the last 3 months, with a score $\geq$ 4 on the average NRS scale [15].

(2) One part of the survey explored whether patients experienced bodily pain other than abdominal/related to the surgery and was evaluated in terms of localization: musculoskeletal (pain from any ligament, tendon, muscle or bone), headache or other (text) and frequency.

(3) A part consisted of the self-report version of the leeds assessment of neuropathic symptoms and signs pain scale (S-LANSS) [16] with the aim to identify pain of predominantly neuropathic origin (a score $\geq$ 12) as distinct from nociceptive pain, within the last week.

(4) The activity assessment scale (AAS) [17] evaluated the pain-related impairment of everyday functioning after abdominal surgery through 13 items covering a broad sample of sedentary to movement-related physical activities. Each item is scored from 1 to 5 points (1 point = no difficulty to perform the activity and 5 points = unable to perform the activity), resulting in a summed raw AAS score from 13 to 65 points, transformed to a percentage ranging from 0 to 100% (0% no pain-related impairment and 100% maximum impairment) and categorized in three groups: no pain-related functional impairment (0%), minimal pain-related functional impairment ($>$ 0–7.7 $<$), moderate pain-related functional impairment ($\geq$ 7.7–30.7% $<$) and severe pain-related functional impairment ($\geq$ 30.7–100%) [18].

(5) Gastrointestinal quality of life (GIQLI) [19], a 36-item questionnaire, explored five domains: core symptoms (10 items), physical status (6 items), psychological status (5 items), social functioning (5 items) and disease specific issues (10 items). Each response is scored from 0 (least desirable) to 4 (most desirable) points. The GIQLI score is the sum of points.

The survey was manually entered into a database by two of the authors. Descriptive statistics using medians with interquartile range (IQR) was used when appropriate. Frequencies and percentages were calculated, and Chi-square was used to compare categorical variables. Mann–Whitney U test was used to compare nonparametric continuous variables. Multivariate logistic regression one-step analysis was used to explore risk factors for CPSP, and odds ratios with 95% confidence interval (95% CI) were given and considered statistically significant if $p < 0.05$. All data analyses were performed using SPSS statistics, version 22.0, Armonk, NY: IBM Corp. 2010.

Results

Primarily, 1573 patients underwent emergency laparotomy. Of these, 605 were eligible for inclusion (Fig. 1) and were contacted. A total of 440 patients completed the survey corresponding to a response rate of 73%. Median follow-up was 60 months (IQR 47).

Median age was 69 years (range 18–95) (IQR 21), 56.4% were female. ASA score was ≥ 3 in 24.3%, BMI > 25 in 38% and performance score was ≥ 2 in 19.5% of the cases, respectively. Demographics are shown in Table 1. The procedures performed were: perforated ulcer 18 (4%), small bowel obstruction/resection/enterostomy 235 (53%), large bowel resection/colostomy 119 (27%), re-operation elective surgery 25 (6%) and other 43 (10%). Intraoperatively, 201 (45.7%) procedures were classified as contaminated-dirty. Duration of the procedures performed was median 119 min/mean 136 min.

APSP was reported in 260 (59%) of the patients with a pain intensity average of moderate–severe in 210 (48%). In 157 (36%) of the cases, patients described their worst experienced pain as severe, NRS 7–10. Pain duration < 1 month was reported by 96 (22%) patients. Pain duration between 1 and 3 months past the surgery was seen in 69 (16%) and persisted since the surgery in 32 (7%) of the cases, respectively. Comparing the population of patients that experienced moderate–severe APSP on average to the rest of the population, there was no difference in gender, age, ASA score, performance score, BMI or any of the comorbidities as mentioned in Table 1. Neither was there any difference in the procedures performed or degree of contamination. There was neither a relation between the duration (≤ 120 min) of surgery and APSP nor did we find any correlation between the different types of procedures performed and APSP.

Abdominal pain related to surgery within the last 3 months (Table 2) was reported by 130 (29.5%) patients, 97 (22%) reported some influence of pain on daily living and 68 (15%) described pain two or more days per week. Chronic postsurgical pain was reported by 85 (19%) of the patients with a severe pain intensity in 68 (15%). CPSP was more likely in the younger patient group where 32% of patients below the age of 60 reported CPSP compared to 14% of patients > 60 years of age, $p < 0.01$. CPSP was reported by 22% of the women and 16% of the men, not statistically different, $p = 0.14$. There was a possible relation between CPSP and the degree of peritonitis; 23% of patients classified contaminated-dirty developed CPSP compared to 16.5% clean-contaminated, but it was not statistically significant, $p = 0.08$. There was no relation between the duration (≤ 120 min) of surgery and CPSP and no correlation between the different types of procedures performed and CPSP.

Patients with CPSP did not differ from the remaining part of the population in terms of ASA, BMI, performance score, comorbidities or procedures performed. Medical assistance because of abdominal pain within the last 3 months was sought by 48 (11%) of the patients and 61 (14%) patients used analgesics for the abdominal pain, 42 (9.5%) two or more days per week. Abdominal pain within the last week was reported by 92 patients and they completed the S-LANNS questionnaire and we identified pain of predominantly neuropathic origin in 25% of those patients.

We found an association between acute and chronic postsurgical pain; 32% of patients that experienced moderate–severe APSP developed CPSP compared to only 7% of patients that reported mild APSP, $p = 0.01$.

Other bodily pain within the last 3 months was reported by 223 (51%) patients. Most common was back pain in 91 (21%) and headache in 19 (4%) and 59 (13%) described pain from more than 2 areas of the body, and 105 (24%) used analgesics two or more times per week for this pain. We found an association between patients reporting other bodily pain two or more times per week, and the experience of moderate–severe APSP compared to mild APSP; 66% versus 51%, $p < 0.01$. Likewise, we found an association between patients experiencing other bodily pain two or more days per week and CPSP or not: 29% versus 15%, $p = 0.01$.

The activity assessment questionnaire was completed by 415 patients. 163 (37%) reported no impairment, 53 (12%) reported minimal impairment, 132 (30%) reported

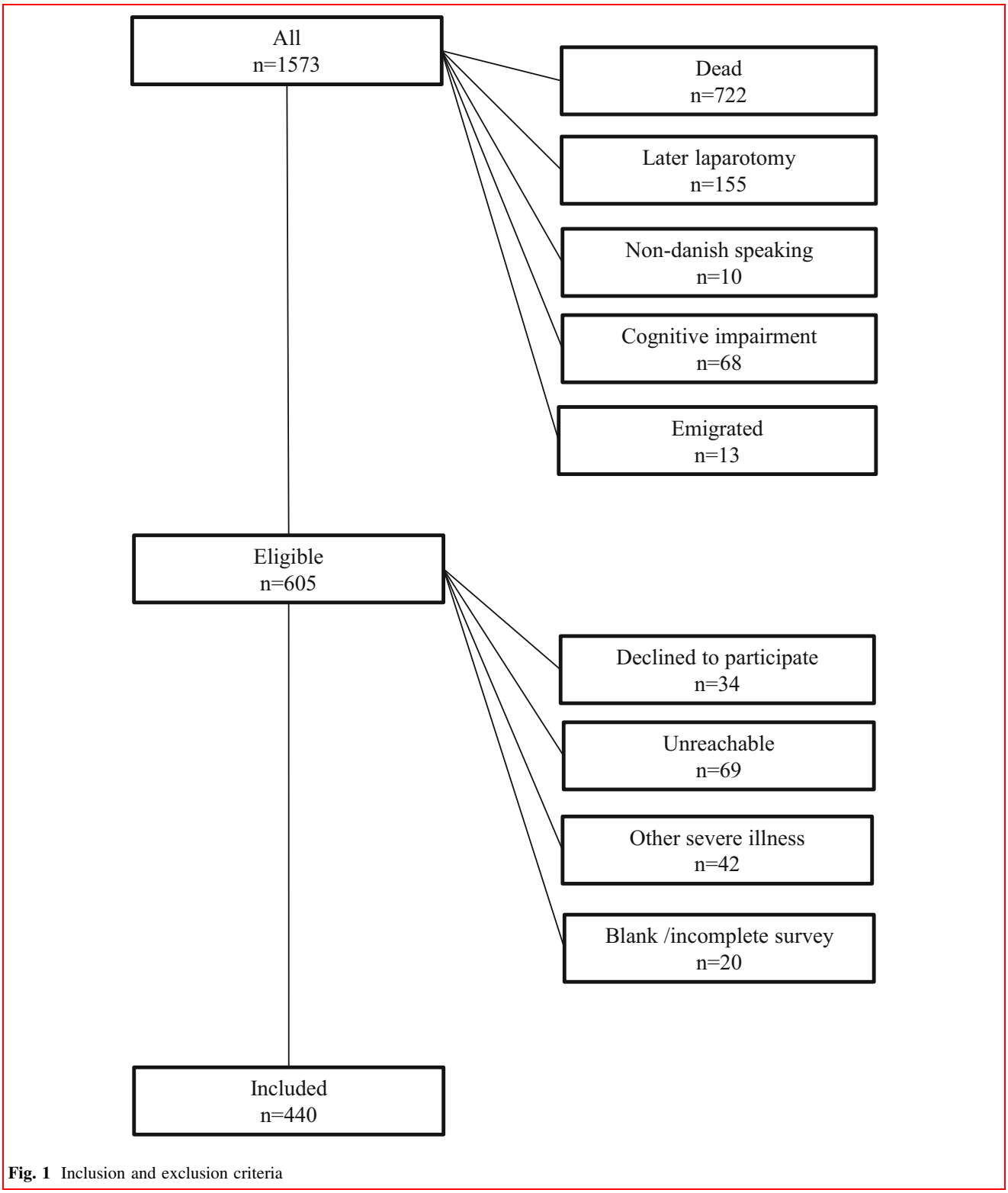

Fig. 1 Inclusion and exclusion criteria

moderate impairment and 67 (15%) reported severe functional impairment as a result of the laparotomy. Figure 2 depicts 5 of the 13 categories of patients' answers to the question: "How much difficulty did you have performing following activities in the last 24 h, as a result of the operation?" regarding different everyday activities. The same question was asked regarding more sedentary activities, where patients answered they had some, or a lot of

Table 1 Demography and comorbidity

All n = 440	Demography and comorbidity	n(%)
Gender, female		248 (56.4)
Age, years	< 40 years	28 (6.4)
	41–60 years	101 (23)
	61–80 years	235 (53.4)
	> 80 years	76 (17.3)
ASA score	I	173 (39.3)
	II	117 (26.6)
	III	92 (20.9)
	IV	10 (2.3)
	Missing	48 (10.9)
Performance	0	260 (59.1)
	1	94 (21.4)
	2	61 (13.9)
	3	23 (5.2)
	4	2 (0.5)
Body mass index	< 20 kg/m^2	39 (8.9)
	20–25 kg/m^2	205 (46.6)
	> 25 kg/m^2	167 (38.0)
	Missing	29 (6.6)
Smoker		86 (19.5)
	Missing	28 (6.4)
Alcohol	> 7/14 units/week*	82 (18.6)
	Missing	32 (7.3)
Comorbidities	Diabetes	27 (6.2)
	Thyroid disease	26 (5.9)
	Cerebrovascular disease	29 (6.6)
	Hypertension	165 (37.6)
	Atrial fibrillation	36 (8.2)
	Ischemic heart disease	52 (11.8)
	Obstructive pulmonary disease	38 (8.6)
	Chronic nephropathy	10 (2.3)
	Cirrhosis	3 (0.7)
	Malignancy	61 (13.9)

Table 2 Chronic postsurgical pain

	All n = 440
Abdominal pain within the past 3 months, n(%)	130 (29.5)
Pain intensity—average, n(%)	
Mild	45 (10.2)
Moderate	66 (15.0)
Severe	19 (4.3)
Pain intensity—at its worst, n(%)	
Mild	18 (4.1)
Moderate	41 (9.3)
Severe	68 (15.5)
Missing	3 (0.6)
Pain frequency, n(%)	
Less than 2 days per week	58 (13.2)
Two or more days per week	26 (5.9)
Daily, not constant	34 (7.7)
Constant	8 (1.8)
Missing	4 (0.9)
Analgesic consumption, n(%)	61 (13.9)
Acetaminophen	24 (5.5)
NSAID	8 (1.8)
Opioids	20 (4.5)
Other	1 (0.2)
Missing	8 (1.8)
Effect of pain on daily living, n(%)	
Not at all	32 (7.2)
Some	65 (14.8)
A lot	22 (5.0)
Very much	10 (2.3)
Missing	1 (0.2)
Pain triggers, n(%)	
Lying position	20 (4.5)
Sitting position	46 (10.5)
Eating	46 (10.5)
Wearing tight clothes	51 (11.6)
Light physical activities	22 (5.0)
Moderate physical activities	38 (8.6)
Strenuous physical activities	34 (7.7)
Pain-disturbed sleep, n(%)	66 (15.0)
S-LANSS score (n = 92), median(range)	5 (0–24)
Neuropathic pain (S-LANSS score $\geq$ 12), n(%)	23 (5.2)

difficulty, or were not able to: sit 24 (6%), get in or out of bed 29 (7%), reach or stretch 29 (7%), lift 1–3 kg 39 (9%), walk around inside 24 (6%), climb up or down stairs 50 (11%) and walk outside or work 50 (11%).

The GIQLI questionnaire was completed by 398 patients and compared between the groups of patients with (n = 79) or without CPSP (n = 319). Patients with CPSP had a significantly lower overall GIQLI score 98 (IQR39) compared to no-CPSP 122 (IQR18), $p < 0.01$ and also lower GIQLI score in all subgroups explored: Core symptoms: 23 (IQR9) versus 34 (IQR8) $p < 0.01$. Physical items: 13 (IQR12) versus 19 (IQR6), $p < 0.01$. Psychological items 14 (IQR8) versus 18 (IQR4), $p < 0.01$. Social function: 12 (IQR8) versus 16 (IQR7), $p < 0.01$. Disease specific items: 31 (IQR8) versus 38 (IQR5), $p < 0.01$.

To estimate risk factors for CPSP, a multivariate regression analysis was performed. Entered in the analysis were gender, age, performance $\geq$ 3, BMI $\geq$ 30, malignancy, other bodily pain two or more days per week, degree of contamination and moderate–severe APSP, as

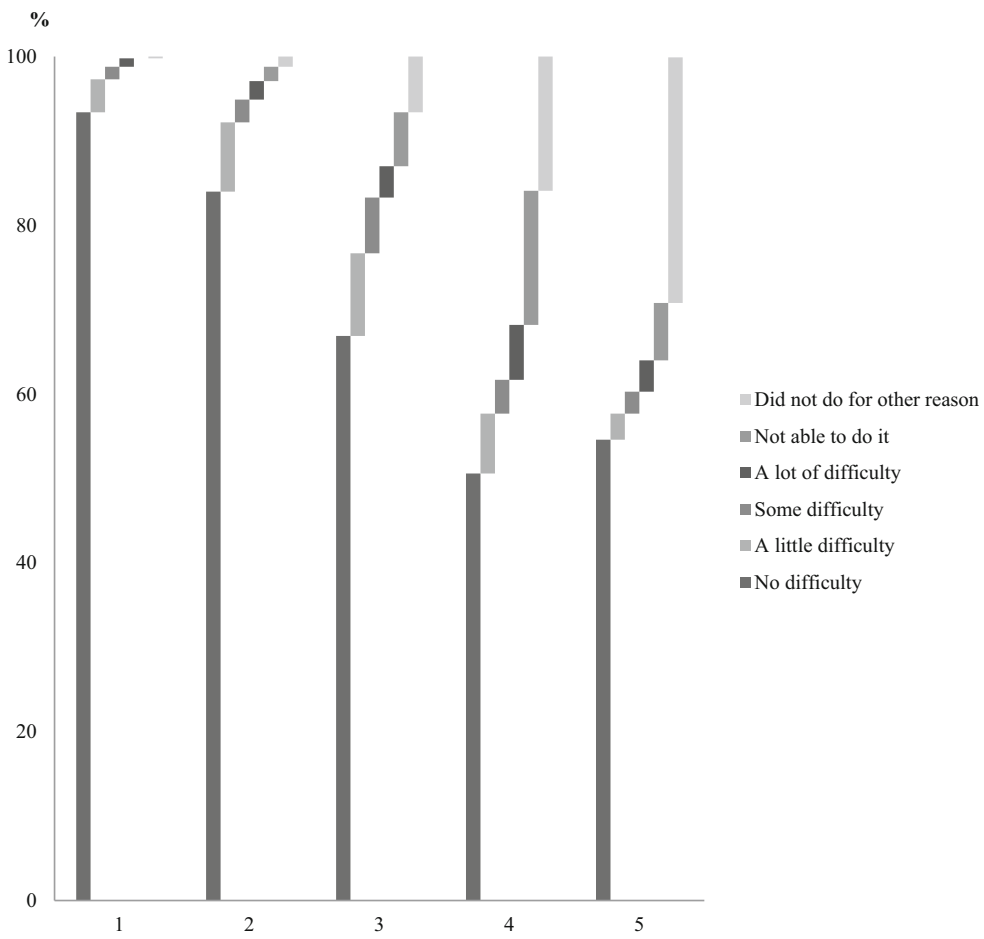

Fig. 2 How much difficulty did you have performing following activities in the last 24 h, as a result of the operation? 1: Engaging in sedentary activities, such as typing, talking on the phone, playing cards and watching TV. 2: Engaging in light physical activities, cooking, dusting, clerical work and visiting friends. 3: Engaging in moderate physical activities such as sweeping, washing the car, dancing, playing golf and hiking. 4: Engaging in vigorous physical activities such as construction work, shoveling, playing tennis or basketball and weightlifting. 5: Engaging in sexual intercourse

Table 3 Risk factors for chronic postsurgical pain

	OR	(95%CI)	*P* value
Gender, female	1.6	(0.9–2.9)	0.12
Age <60 years of age	**2.1**	**(1.2–3.8)**	**0.01**
Other pain >2 days per week*	1.7	(0.9–3.1)	0.08
Performance score ≥3	0.7	(0.2–2.8)	0.63
Malignancy	0.9	(0.4–2.2)	0.76
Contaminated-dirty**	1.7	(1.0–3.1)	0.06
Acute postsurgical pain	**5.0**	**(2.4–10.5)**	**<0.01**

P values < 0.05 are given in bold

*Pain other than related to surgery (musculoskeletal, headache or other)

**Intraoperative contamination degree according to Mangram[13]

given in Table 3. We identified APSP OR 5.0 95%CI (2.4–10.5), $p < 0.01$ and young age OR 2.1 95%CI (1.2–3.8), $p = 0.01$ as independent risk factors for CPSP. We also found an association between intraabdominal contamination and chronic pain (other than related to the surgery) and CPSP, but the results were not statistically significant.

Discussion

Chronic pain, low gastrointestinal QoL and functional impairment were common after emergency laparotomy. One in five patients experienced pain, and almost every second, patient had functional impairment due to pain. CPSP was especially seen in the younger population (one in three patients below 60 years), and CPSP was also associated with lower gastrointestinal QoL.

The high rate of CPSP has been described by others after elective laparotomy and after various general surgery in 10–40% [2, 20]. Pain-disturbed sleep, mood disturbances and interference with enjoyment of life were also reported after elective gastrointestinal surgery [21], but very little has been reported on emergency laparotomy. One study on emergency laparotomy due to small bowel obstruction described a prevalence of CPSP similar to this study of 21% [14].

The mechanisms behind CPSP are complex and multifactorial. Hypotheses include preoperative, intraoperative and postoperative factors. Preoperative conditions might relate to younger age, females, preexisting pain,

comorbidities and possibly psychological vulnerability [1, 22–25]. In this study, we identified age < 60 as an independent risk factor for developing CPSP as we found an association to pain other than related to surgery. Young age doubled the risk for developing CPSP. Female gender showed a possible association. We found no association between comorbidities and CPSP. Intraoperative factors are related to the incision and surgical technique, and nerve damage and inflammatory mediators can cause neural sensitization and lead to CPSP [26, 27]. Peritonitis was in this study associated with the development of CPSP and may be related to the visceral component of pain or indirectly mediating the severity of the underlying pathology/disease [28].

The strongest independent predictor for CPSP in this study was moderate–severe acute postsurgical pain with five times the risk compared to patients experiencing mild pain. APSP is a known risk factor from previous studies and is suggested treated more aggressively to reduce the risk of CPSP [29].

We found a high rate of functional impairment on long-term follow-up after emergency laparotomy. With a median follow-up of 60 months, 45% experienced moderate to severe functional impairment especially engaging in physical activities. The activity assessment questionnaire was originally designed to describe pain-related impairment of everyday activities after elective hernia surgery [17] and was also validated in women undergoing pelvic reconstructive surgery [30] describing pain-related impairment at a 6-month follow-up. Only one study on emergency laparotomy due to small bowel obstruction has previously described pain-related functional impairment of 19% on long-term follow-up, median 37 months [14]. Apart from that, no other study has previously described this kind of functional disability after emergency laparotomy, and the results need to be confirmed in other studies and investigated further in the future.

We acknowledge several limitations for this study. Patients were asked to describe acute postsurgical pain experienced years back, and the study might include recall bias. There is a risk of possible selection bias since the original study population was reduced to only 40% eligible patients mostly because of death, later laparotomy or cognitive impairment. External validity may be compromised, and results may not be generalizable. The strength of this study is the large sample size and minimal missing data for the patients who completed the study. It is also one of few prospective studies to describe long-term outcomes after emergency laparotomy.

Emergency laparotomy is a high-risk procedure, and negative outcomes have traditionally been described through morbidity and mortality rates. Through the last decade, improved outcomes have been achieved by standardizing perioperative care with a care-bundle approach containing principles from enhanced recovery programs containing standards such as early resuscitation and antibiotic treatment, multidisciplinary specialist led care, surgery within 6 h, goal-directed fluid therapy and postoperative intensive/intermediate care, standardized analgesic regimen, early mobilization and enteral nutrition [31, 32], but the impact on clinical long-term outcome is still unclear. Further research especially regarding post-operative care and standardized follow-up methods is necessary in the future and may help to improve the functional patient-related outcomes.

In conclusion, CPSP and low gastrointestinal QoL were common after emergency laparotomy. Younger age and APSP were risk factors for CPSP. Almost every second, patient experienced moderate–severe functional impairment. The mechanisms of CPSP are not fully understood. There is definitely a need for more research in order to identify further modifiable factors in the perioperative setting and to clarify the long-term consequences after emergency laparotomy. Perioperative care-bundle approach including multimodal analgesic treatment could be an initial strategy for quality improvement.

Compliance with ethical standards

Conflict of interest All authors declares that they have no conflict of interest.

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