

Nationwide analysis of prolonged hospital stay and readmission after elective ventral hernia repair

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ABSTRACT

INTRODUCTION: Early outcome after elective ventral hernia repair is unsatisfactory, but detailed analyses are lacking. The aim of this study was to describe the aetiology of prolonged hospital stay (LOS), readmission and death < 30 days after elective ventral hernia repair.

MATERIAL AND METHODS: The present study was a nationwide case-control study based on prospective results from elective ventral hernia repairs (incisional, umbilical/epigastric, parastomal and other rare ventral hernia repairs) performed in Denmark during 2008. The exclusion criteria were emergency operation and ventral hernia repair in addition to another surgical procedure. The study group were patients with poor outcome (a LOS \geq 5 days and/or readmission and/or death \leq 30 days) and the control group were patients without a poor outcome. Major complications were defined as severe and potentially fatal complications.

RESULTS: The cohort included 2,258 patients (a study group counting 258 patients (259 repairs) and a control group comprising 2,000 patients (2,016 repairs)). Patients in the study group underwent repair significantly more often for incisional (76% versus 28%, $p < 0.001$), parastomal (3% versus 1%, $p = 0.001$) and recurrent hernia (21% versus 12%, $p < 0.001$). Furthermore, hernia defects were significantly larger (median 8 cm versus 2 cm, $p < 0.001$) in the study group than in the control group. Prolonged LOS was mainly due to pain (27%), major complications (19%), and seroma formation (9%). Readmissions were primarily caused by wound infections and pain.

CONCLUSION: Readmissions and prolonged hospital stay after ventral hernia repair were mainly due to pain, major complications, wound infections and seroma formation.

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TRIAL REGISTRATION: The study was registered with the Danish Data Protection Agency (ref. no. 2008-58-0020) and www.clinicaltrials.gov (ref. no. NCT01388634).

No detailed large-scale data are available to explain prolonged length of hospital stay (LOS) and readmission following ventral hernia repair. Recent nationwide Danish data from the 2005-2006 period have shown an unsatisfactory 30-day outcome following elective incisional hernia repair [1]. The study comprised 2,896 incisional

hernia repairs and showed that the postoperative morbidity, readmission and mortality rates were 11%, 11% and 0.4%, respectively. Ten percent of the patients stayed in hospital for > 6 days after surgery [1]. National Danish data following elective and predominantly small umbilical and epigastric hernia repairs ($n = 3,431$) have shown low morbidity and mortality rates (4% and 0.1%, respectively), but an unexpectedly high readmission rate (5%) [2]. No differences in outcome after incisional and umbilical/epigastric hernia repair were found between open or laparoscopic procedures [1].

The aim of the present study was to analyse factors associated with prolonged LOS, readmission and death in a nationwide group of patients undergoing elective ventral hernia repair in search for areas of interest to improve outcome after ventral hernia surgery.

MATERIAL AND METHODS

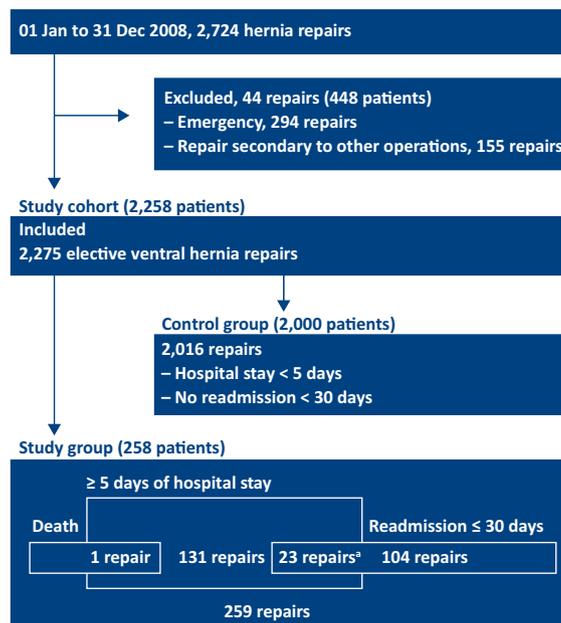
This was a descriptive Danish case-control study based on prospective results after elective ventral hernia repair during 2008. Data comprised all elective ventral

ORIGINAL ARTICLE

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FIGURE 1



Flow chart of study profile. The Danish Ventral Hernia Database and The Danish National Patient Register (2,706 patients).

a) In 23 ventral hernia repairs patients were hospitalized \geq 5 days and were furthermore readmitted \leq 30 days after operation.

hernias registered in the Danish Ventral Hernia Database (DVHD) and Danish National Patient Register (DNPR) (study cohort, **Figure 1**). Ventral hernias were defined as incisional, umbilical/epigastric, parastomal or other rare hernia repairs. The perioperative data in the DVHD are registered online by the operating surgeon immediately after the operation [3]. The prospective data from the DVHD were matched with data from the DNPR using each patient's social security number. By combining data from the two databases, we obtained information from the DNPR (gender, age, LOS, readmission, other procedures performed and contacts to the health-care system), as well as technical information about the ventral hernia repair from the DVHD (type of hernia, laparoscopic or open repair, use of mesh, size (wide and length) of hernia and mesh, type of mesh or suture, mesh fixation,

emergency or elective repair, primary or recurrent repair). Data (study group) were supplemented with retrospective information from manual analyses of patients' medical records. The exclusion criteria were emergency repairs and hernia repairs with additional surgical procedures unrelated to the hernia repair.

The study group included patients with poor outcome defined as LOS \geq 5 days and/or readmission and death within 30 days. The control group were patients without poor outcome (Figure 1).

LOS was defined as the period from surgery to discharge from hospital (1 day = 24 hours). LOS during readmission was not included in the calculation of post-operative LOS. Ventral hernia repairs were divided into incisional, umbilical/epigastric, parastomal and a group of rare hernia repairs (Spigelian, lumbar, trocar, etc.). The size of the hernial defect was defined as the widest described diameter (cm) of the defect.

Patients' medical records (study group) were analysed according to well-defined predetermined parameters: The existence of co-morbidity in the study group was defined as a medically treated disease (we had no information of co-morbidity in the control group). Major perioperative complications were defined as severe and potentially fatal complications (intraoperatively recognized visceral perforation, thromboembolic complications, intensive care treatment) or as complications requiring emergency reoperation, excluding superficial skin opening, skin puncture and skin drainage. Minor perioperative complications were other complications not included in the above definitions. Pain causing prolonged LOS was defined as pain treated with intravenous opioids. If causes for prolonged LOS were not obvious in the hospital files, consensus was obtained through discussion between the investigators to identify reasons for prolonged LOS. In cases in which the LOS or readmission was not explained by a major or minor complication, we registered the other explanations entered into the medical records.

Statistics

The morbidity and mortality rates were based on the number of hernia repairs and number of patients, respectively. To prevent statistical distortion of morbidity results, we assessed only one complication (the most severe) per hernia repair [4]. Data are presented as exact numbers and percentages. Confidence intervals for proportions (95%) were calculated between the study group and control group for the specific hernia repairs. Non-parametric statistics was used in order to analyse differences in hernia sizes (Mann-Whitney) and chi square test was used to compare categorical data between the study group and the control group. A p value < 0.05 was considered statistically significant.



TABLE 1

Control group: outcome from elective ventral hernia repairs registered in The Danish Ventral Hernia Database 2008.

	Incisional (n = 563)	Umbilical/ epigastric (n = 1,364)	Parastomal (n = 21)	Other (n = 68)	Total (n = 2,016)
Age, years, median (range)	60 (19-96)	51 (19-91)	60 (40-80)	55 (25-88)	53 (19-96)
Gender (F:M), no.	302:250	489:870	10:11	48:20	849:1,151
Hernia size ^a , cm, median (range)	6 (0-30)	1 (0-20)	5 (1-8)	2 (0-15)	2 (0-30)
Primary hernia:recurrent hernia, n	452:111	1,275:89	20:1	60:8	1,807:209
Open repair, n (%)	244 (43)	1,164 (85)	10 (48)	48 (71)	1,466 (73)
Laparoscopic repair, n (%)	319 (57)	200 (15)	11 (52)	20 (29)	550 (27)
Use of mesh, n (%)	486 (86)	598 (44)	19 (90)	43 (63)	1,146 (57)
Hospital stay, median days (range)	1 (0-4)	0 (0-4)	2 (0-4)	1 (0-4)	1 (0-4)

F = female; M = male; n = number of ventral hernia repairs; no. = number of patients.

a) Widest diameter.



TABLE 2

Study group: outcome from patients with \geq 5 days of hospitalization and/or readmission after elective ventral hernia repair.

	Incisional (n = 197)	Umbilical/ epigastric (n = 42)	Parastomal (n = 9)	Other (n = 11)	Total (n = 259)
Age, years, median (range)	61 (19-96)	53 (24-83)	64 (37-89)	63 (58-73)	61 (19-96)
Gender (F:M), no.	107:89	20:22	7:2	9:2	143:115
Co-morbidity, no. (%)	128 (65)	19 (69)	6 (67)	9 (82)	172 (66)
Hernia size ^a , cm, median (range)	12 (1-33)	2 (1-11)	7 (2-12)	2 (1-6)	8 (1-33)
Primary hernia:recurrent hernia, n	154:42	34:8	9:0	11:0	208:50
Open repair, n (%)	102 (52)	22 (52)	3 (33)	6 (55)	133 (51)
Laparoscopic repair, n (%)	95 (48)	20 (48)	6 (67)	5 (45)	126 (49)
Use of mesh, n (%)	188(96)	31 (74)	9 (100)	8 (73)	236 (92)
Hospital stay, median days (range)	5 (0-99)	1 (0-9)	5 (2-13)	3 (0-11)	5 (0-99)
Readmission, n (%)	86(44)	30 (72)	5 (56)	6 (55)	127 (49)
Mortality, no. (%)	0	0	1 (11)	0	1 (0.4)

n = number of ventral hernia repairs; no. = number of patients.

a) Widest diameter.

Trial registration: The study was approved by the Danish Data Protection Agency (ref. no. 2008-58-0020) and registered in www.clinicaltrials.gov (ref. no. NCT01388634).

RESULTS

The study profile is shown in Figure 1 and patients' characteristics are given in **Table 1** and **Table 2**. Overall, the study cohort contained 2,258 patients (2,275 repairs). The study group and the control group consisted of 258 patients (259 repairs) and 2,000 patients (2,016 repairs), respectively. In total, 132 patients had a LOS ≥ 5 days (one patient died, one patient had two repairs causing a LOS ≥ 5 days), 104 patients had a LOS < 5 days, but were readmitted ≤ 30 days, and 23 patients had a prolonged hospital stay (≥ 5 days) and were subsequently readmitted within 30 days postoperatively. In 12 patients, the principal reason for prolonged LOS was unclear. Thus, principal reasons were identified through discussions between the investigators.

Repair for incisional and parastomal hernia was significantly more frequent in the study group than in the control group (76% versus 28% and 3% versus 1%, respectively, $p \leq 0.001$, Table 1 and Table 2). Poor outcome was found in 26% (95% confidence interval (CI): 23-29) after incisional hernia repair, 30% (95% CI: 14-44%) after parastomal hernia repair and in 3% (95% CI: 2-4%) after umbilical/epigastric hernia repairs (Table 1 and Table 2). Compared with the control group, the study group was characterised by larger hernia defects (median 8 cm versus 2 cm, $p < 0.001$) and by a larger proportion of recurrent hernia repairs (21% versus 12%, $p < 0.001$).

The reasons for poor outcome (prolonged LOS and/or readmission) registered in medical records are shown in **Table 3**. Major complications (especially wound dehiscence and/or deep infection and cardiovascular events), minor complications (especially seroma formation and infections) and pain were the three main reasons. Among patients with a prolonged LOS, major complications were observed in 30 patients (19%), 43 patients (34%) were readmitted due to major complications and 38 patients (30%) underwent emergency reoperation after the readmission. During the prolonged LOS, 18 patients (12%) underwent emergency reoperation (perforated ulcer ($n = 1$), wound dehiscence ($n = 2$), intra-abdominal bleeding ($n = 5$), ileus ($n = 4$, one patient died shortly after the operation), anastomotic leak ($n = 1$) and visceral perforation ($n = 5$)). Thus, 11 patients (bleeding, anastomotic leak, visceral perforation) had a reoperation as a result of insufficient primary surgery. In 42 (27%) patients, pain with no apparent explanation was the single other important factor causing prolonged LOS. In 14 patients, seroma formation was the primary reason for prolonged LOS. In 19 (12%) repairs, no reason

was given in the patient records to explain the long LOS (Table 3).

A total of 43 patients (34%) were readmitted due to major complications and 38 patients (30%) underwent emergency reoperation after readmission (24 deep wound infections, four early ventral hernia recurrences, three perforated ulcers, three visceral lesions, three major bleeding and one ileus). Pain and minor wound infections caused readmissions after 18 (14%) and 14 (11%) repairs, respectively (Table 3).

DISCUSSION

In this case-control study based on nationwide Danish data, we found a poor outcome in 11% of patients undergoing elective repair for a ventral hernia. Important risk

TABLE 3

Causes to explain prolonged hospitalisation ≥ 5 days and/or readmission after ventral hernia repair.

Main causes (259 repairs)	≥ 5 days hospital stay ^a (n = 155, no. = 154)	Readmission < 30 days ^a (n = 127, no. = 127)
<i>Major complications, no.</i>		
Death	1	–
Cardiovascular	6	2
Pulmonary	2	–
Renal failure	2	–
Visceral lesion/perforation	7	3
Anastomosis leak	1	–
Obstructive ileus	3	1
Reoperation for bleeding	5	3
Wound dehiscence or deep wound infection	2	24
Perforated or bleeding ulcer	1	3
Hernia recurrence	–	6
Short bowel syndrome caused by bowel resection at hernia repair	–	1
Total major complications	30	43
<i>Minor complications, no.</i>		
Cystitis, pneumonia and unexplained fever	12	5
Superficial wound infection	2	14
Seroma formation	14	6
Paralytic ileus ≥ 5 days	13	5
Haematoma	8	8
Mild respiratory insufficiency	1	–
Total minor complications	50	38
<i>Various, no.</i>		
Pain	42	18
No explanation mentioned ^b	19	–
Miscellaneous ^c	13	23
Suture or drain removal	0	2
Gastritis	1	3
Total factors, n	155	127

n = number of ventral hernia repairs; no. = number of patients.

- 23 patients both had prolonged hospitalization and were readmitted; they appear in both study groups.
- An explanation for prolonged length of hospital stay could not be obtained from the hospital file.
- Urinary retention, epidural related spinal headache, urticaria, low sodium, anticoagulant treatment, dementia and factors unrelated to the ventral hernia repair.

factors were repair for incisional, parastomal, and recurrent hernia as well as repair for large hernia defects.

The DVHD is a national database in which all surgeons are obliged to register ventral hernia repairs [3]. The DVHD currently covers 80% of all ventral hernias performed in Denmark [3]. The DNPR is closely related to reimbursement in the Danish health-care system (public and private) and is considered to cover close to 100% of all contacts to the health-care system and surgical procedures in Denmark [5-7]. As in the DVHD, data in the DNPR are based on patients' social security number and therefore it is possible to combine data from the two databases to obtain data about LOS, readmissions, death, etc. In the present study, we included patients with prolonged LOS and readmission since LOS is probably a valid proxy for morbidity after ventral and inguinal hernia repair [1, 8]. In Denmark, almost all contacts to the health-care system are promoted by the general practitioner [9]. Our results may therefore underestimate the incidence of complications, especially minor wound infections.

Large and complex hernias are a technical challenge to repair and may be beset with a high risk of complications of up to 48% [1, 10, 11]. The presence of complex hernias and technical challenges could in part explain our results, since the control group and study group were comparable in terms of gender and age, but not in terms of type and size of hernia and therefore may reflect findings in the literature [12-15]. Nevertheless, we demonstrated a prolonged LOS even in patients with no obvious complications or clinical complaints as judged by the medical records. It may therefore be argued that optimised perioperative care and fast track regimens are important to improve outcome in patients undergoing ventral hernia repair [16]. Interestingly, our readmission rate and LOS of approximately 3% after umbilical/epigastric hernia repair is comparable with findings from more complex gastrointestinal surgical procedures such as gastric bypass operations [17].

Major and potentially fatal complications caused 19% and 34% of the cases of prolonged LOS or readmission, respectively. Nevertheless, only one patient died within 30 days after elective hernia repair. In 27% of patients with prolonged LOS pain, the only complaint was without relation to hernia size, suggesting that pain reduction is a major topic in the search for better results after ventral hernia surgery [18]. Wound infection was an important cause for readmission after ventral hernia repair. Wound dehiscence and deep wound infections imply serious morbidity and may even lead to recurrent hernia repair [19].

In conclusion, repair for incisional-, parastomal-, recurrent and large hernia defects were important risk factors for a poor outcome. Prolonged LOS and readmis-

sion were mainly caused by pain, major complications, wound infections and seroma formation. Thus, there is still plenty of room for improvement in the surgical treatment of complex ventral hernias.

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