

## A nationwide study on readmission, morbidity, and mortality after umbilical and epigastric hernia repair

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Received: 27 December 2010 / Accepted: 14 April 2011 / Published online: 3 May 2011  
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### Abstract

**Background** Repair for umbilical and epigastric hernia is a minor and common surgical procedure. Early outcomes are not well documented.

**Methods** All patients  $\geq 18$  years operated on for umbilical or epigastric hernia in Denmark during a 2-year period (2005–2006) were analysed according to hospital stay, risk of readmission, complications, and mortality <30 days after operation. Patients with acute operations and patients having an umbilical and epigastric hernia repair secondary to other surgical procedures were excluded. Results were based on data from the National Patient Registry.

**Results** A total 3,431 operations (open repairs 3,165; laparoscopic repairs 266) in 3,383 patients were performed. The median hospital stay was 0 day (range 0–61 days) (open 0 day; laparoscopic 1 day); 75% stayed in hospital for 0 days, 20% for 1 day and 5% > 1 day. Readmissions occurred in 5.3% of cases (open 4.9%; laparoscopic 10.5%). In the majority of patients readmissions were due

to wound-related problems (haematoma, bleeding and/or infection) (46%), seroma (19%), or pain (7%). At 30 days, complications and mortality occurred in 4.1% (open 3.7%; laparoscopic 8.2%) and 0.1% (open 0.1%; laparoscopic 0.4%), respectively.

**Conclusion** This first prospective nationwide study on elective umbilical and epigastric hernia repair found low morbidity and mortality but a high readmission rate mostly because of wound problems, seroma formation, or pain. Future research should focus on early outcomes in terms of wound problems, seroma formation, and pain after umbilical and epigastric hernia repair.

**Keywords** Adult · Hernia/ventral · Denmark/  
epidemiology · Postoperative complications/mortality

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## Introduction

Despite the fact that umbilical and epigastric hernia repairs are common, and minor, surgical procedures, they are scarcely documented in terms of early outcomes. Thus, available studies are mostly single institution studies with a limited number of patients or with a primary focus on recurrence [1].

Prospective nationwide studies on inguinal hernia repair have provided solid quality assessment [2–5], but currently there are no nationwide studies on early outcomes after umbilical and epigastric hernia repair and there is no national or international agreement (i.e. evidence) on the optimal surgical technique (laparoscopic vs open, mesh vs no mesh, suture type etc.) [6, 7].

Our objective was therefore to analyse nationwide results of early outcomes in patients undergoing primary elective umbilical or epigastric hernia repair in Denmark during a 2-year study period. For this purpose we used the Danish National Patient Registry (NPR), which includes all operations and hospital admissions (administrative and clinical data) in Denmark independent of site of admission.

## Materials and methods

### Data

Postoperative outcomes at 30 days were analysed in all elective umbilical and epigastric hernia repairs performed in Denmark between 1 January 2005 and 31 December 2006. Patients <18 years and patients having acute operations and umbilical or epigastric hernia repair, or procedures secondary to other operations were excluded. Results were based upon patient data from the NPR and operation code. Open and laparoscopic operations were identified by the national code numbers (KJAE10, KJAE11, KJAE30, KJAF10, KJAF11, KJAF20, KJAF30, KJAF96, KJAF97). The NPR also provided information about the use of mesh but provided no data on type, fixation or placement of the mesh, or the use of different types of sutures. The NPR system allows registration of all readmissions independently of primary site of surgery and type of institution (public or private). The validity of the NPR system on the type of surgical procedure, independent of diagnosis and type of operation has previously been established for several surgical procedures [8–12]. Our sources of data contained no information on the patients' preoperative co-morbidity or size of hernia. Based on NPR data and patients discharge records we analysed total hospital stay (primary plus readmission within 30 days), readmission rate, 30-day mortality and 30-day morbidity. Discharge records were analysed independently by two investigators

in case of death, length of stay more than 1 day, reoperation, and readmission within the first 30 postoperative days. Thus, complications were classified as related to the operation as: definitely, possibly, or unlikely to be related. Only definitely and possibly related deaths and complications were regarded as positive events and included in the analysis. Minor and major complications were defined before data analysis, and during analysis discrimination between minor and major complications was made by the same two investigators. We defined major complications as severe and potentially fatal complications, or as complications requiring reoperation excluding skin opening and skin puncture or skin drainage [13]. Minor complications were other complications not defined as major complications. Visceral lesions (major complication) were defined as non-recognised intraoperative bowel lesions identified at re-laparotomy. In case of disagreement between the investigators consensus was obtained through discussion.

### Statistics

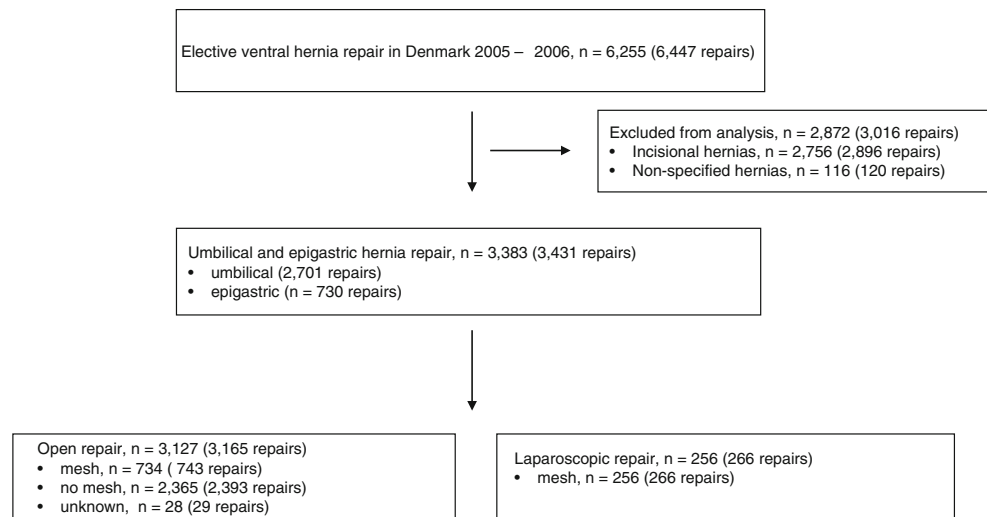
To avoid statistical analysis within a “wrong sampling unit” (as several events may occur per patient and per surgical procedure) and thus to prevent a statistical distortion of our morbidity results, we assessed only one complication (the most severe) per hernia repair [13]. The most severe complication was regarded as a relative measure (major versus minor severe). Mortality rate was based on the number of patients who died within 30 days after the operation, whereas rates of readmission, reoperation, and morbidity were based on the number of hernia repairs. Because of the non-randomised national cohort study design, a statistical comparison between open and laparoscopic hernia repair was not performed. Data is presented as exact numbers and percentages.

## Results

The study design is shown in Fig. 1. During the 2-years study period, 6,447 ventral hernia repairs (umbilical, epigastric, incisional, and non-specified) were performed in 6,255 patients. Early outcomes after incisional hernia repair have recently been reported elsewhere [14].

In total, 3,431 umbilical (2,701 repairs) and epigastric (730 repairs) hernia operations were performed in 3,383 patients (3,165 open repairs and 266 laparoscopic mesh repairs) (Fig. 1; Table 1). All laparoscopic repairs were with a mesh (Fig. 1).

Demographic data and 30-day outcome results stratified into open and laparoscopic hernia repair are shown in Table 1. The median total hospital stay was 0 day (range

**Fig. 1** Study design**Table 1** Demographic data and 30-day outcome results after a total of 3,431 umbilical and epigastric hernia repairs in Denmark, 2005–2006

Demographics and outcome	Open repair (n = 3,165)	Laparoscopic repair (n = 266)	Total (n = 3,431)
Age (years, range)	50 (18–92)	52 (27–90)	50 (18–92)
Females, no. (%)	1,067 (33.7)	73 (27.4)	1,140 (33.2)
Hospital stay (days)			
Median (range)	0 (0–61)	1 (0–31)	0 (0–61)
Mean (SD)	0.4 (1.9)	1.8 (3.1)	0.5 (2.0)
Readmission <sup>a</sup> , no. (%)	155 (4.9)	28 (10.5)	183 (5.3)
Reoperation <sup>b</sup> , no. (%)	61 (1.9)	8 (3.0)	3 (0.1)
Mortality <sup>a</sup> , no. (%)	2 (0.1)	1 (0.4)	3 (0.1)
Major complications <sup>a</sup> , no. (%)			
Visceral lesion/mechanical bowel obstruction	0 (0)	1 (0.4)	1 (0.03)
Wound or fascial rupture/early recurrence	9 (0.3)	1 (0.4)	10 (0.3)
Pulmonary complications	4 (0.1)	0 (0)	4 (0.1)
Complicated ulcer	3 (0.1)	0 (0)	3 (0.09)
Cardiac related complications <sup>c</sup>	2 (0.1)	0 (0)	2 (0.06)
Cardiac arrest <sup>d</sup>	1 (0.03)	0 (0)	1 (0.03)
Multi-organ failure (MOF) <sup>e</sup>	0 (0)	1 (0.4)	1 (0.03)
Bleeding from eosophagitis/gastritis	1 (0.03)	1 (0.4)	2 (0.06)
Bone fracture (due to accidental fall)	1 (0.03)	0 (0)	1 (0.03)
Total major complications	21 (0.7)	4 (1.5)	25 (0.7)
Minor complications <sup>a</sup> , no. (%)			
Wound haematoma/bleeding	29 (0.9)	8 (3.0)	37 (1.1)
Wound infection/necrosis	39 (1.2)	2 (0.8)	41 (1.2)
Seroma	14 (0.4)	5 (1.9)	19 (0.6)
Urologic/gynaecologic complications	8 (0.3)	2 (0.8)	10 (0.3)
Neurologic incident	1 (0.03)	0 (0)	1 (0.03)
Miscellaneous	5 (0.2)	1 (0.4)	6 (0.2)
Total minor complications	96 (3.0)	18 (6.8)	114 (3.3)
Total minor and major complications, no. (%)	117 (3.7)	22 (8.2)	139 (4.1)

Only one (the most severe) complication was recorded per hernia repair. Complicated ulcer was bleeding or perforated ulcer and upper gastrointestinal bleeding was verified by gastrointestinal endoscopy in all cases. Percentages are in parenthesis unless stated otherwise, *n* Number of repairs, *no.* number of patients

<sup>a</sup> Within 30 days after primary operation;

<sup>b</sup> Reoperations included skin opening, drainage, endoscopic therapy, and laparotomy

<sup>c</sup> Excluding cardiac arrest

<sup>d</sup> Cardiac arrest with successful resuscitation

<sup>e</sup> MOF without signs of visceral lesion or mechanical bowel obstruction at re-operation

0–61 days) (open 0 day (0–61); laparoscopic 1 day (0–31), and 75% stayed in hospital for 0 days, 20% for 1 day, and 5% > 1 day.

Outcome results stratified into open umbilical and open epigastric hernia repair (subdivided into mesh and no mesh) are shown in Table 2. Open umbilical repair was

**Table 2** Outcome results after 3,136 open umbilical and epigastric hernia repairs in Denmark, 2005–2006 with or without a mesh

Outcome, <i>n</i> = 3,136	Open umbilical repair			Open epigastric repair		
	Mesh ( <i>n</i> = 724)	No mesh ( <i>n</i> = 1,682)	Total ( <i>n</i> = 2,404)	Mesh ( <i>n</i> = 19)	No mesh ( <i>n</i> = 711)	Total ( <i>n</i> = 730)
Readmission, <i>n</i> (%)	55 (2.3)	70 (2.9)	125 (5.1)	1 (1.4)	27 (3.7)	28 (3.8)
Reoperation, <i>n</i> (%)	23 (1)	29 (1.2)	52 (2.2)	1 (1.4)	8 (1.1)	9 (1.2)
Mortality, no. (%)	0 (0)	2 (0.1)	2 (0.1)	0 (0)	0 (0)	0 (0)
Complications, <i>n</i> (%)	41 (1.7)	51 (2.1)	92 (3.8)	1 (1.4)	22 (3)	23 (3.2)

The total number of umbilical and epigastric repairs was 3,431 [laparoscopic repairs (*n* = 266) and repairs with unclear use of mesh (*n* = 29) were excluded]. Complications included minor and major complications (see Table 1 for details). Percentages are in parenthesis. *n* Number of repairs, *no.* number of patients

performed with and without a mesh in 724 and 1,682 procedures, respectively. Epigastric repairs (all coded as open procedures) were with and without a mesh in 19 and 711 procedures, respectively (Table 2). In total, open repair was with and without a mesh in 743 and 2,393 procedures, respectively (in 29 procedures there were no information on mesh) (Table 2; Fig. 1). There were no important differences in outcome results regarding open umbilical and epigastric hernia repair, and mesh or no mesh (Table 2).

Major complications were observed in 0.7% (open 0.7%; laparoscopic 1.5%) and total morbidity was 4.1% (open 3.7%; laparoscopic 8.2%) (Table 1). Three patients died <30 days after repair: A 53-year-old male patient had elective open umbilical hernia repair despite severe pre-operative decompensated liver cirrhosis. On the 12th postoperative day the patient underwent an acute operation for a perforated duodenal ulcer. The patient developed hepatic coma and died on day 14. Another patient (57-year-old male patient; history of severe alcohol abuse and compensated liver cirrhosis) died because of multi-organ failure and respiratory distress syndrome 27 days after a laparoscopic umbilical hernia repair. Neither re-laparotomy nor post-mortem examination revealed any explanation for the fatal course. Finally, a 63-year-old male patient with no previous medical history was found dead in his home 7 days after ambulatory open umbilical hernia repair. Post-mortem examination revealed acute myocardial infarction.

Results on readmission rate <30 days and explanatory factors are given in Table 3. Readmission occurred in 5.3% (open 4.9%; laparoscopic 10.5%). Wound related problems (haematoma, bleeding and/or infection), seroma, and pain were the three main explanatory factors for readmission.

## Discussion

These nationwide results suggest acceptable low morbidity and low mortality after primary elective repair of umbilical and epigastric hernia. However, the study documented a

**Table 3** The five factors most frequently responsible for the 183 readmissions to hospital <30 days after a total of 3,431 umbilical and epigastric hernia repairs

3,431 hernia repairs	183 readmissions (5.3)
Wound related problems/complications	85 (46)
Seroma	19 (10)
Pain with negative clinical finding	12 (7)
Urologic/gynaecologic complaints/complications	10 (6)
Cardiac related complaints/complications	7 (4)
Miscellaneous	50 (27)
Total	183 (100)

Results are number of readmissions (%)

high readmission rate of approximately 5%, due mainly to wound-related problems, seroma formation, or pain.

The present study did not include patients undergoing acute hernia repair or patients having a hernia repair secondary to other surgical procedures, since we aimed at analysing a homogenous group of patients. Our study was undertaken to analyse potential challenges after elective umbilical and epigastric primary hernia repair. In this study we focused on early outcome in terms of readmission, morbidity and mortality, and we used the unique Danish NPR, which includes all operations and hospital admissions (administrative and clinical data) in Denmark independent of site of admission.

The present analysis is epidemiological and based on non-randomised data. As mentioned earlier, the NPR system does not provide information on patients' comorbidity, size of the hernia defect, or data on individual surgical expertise. In this study, the number of epigastric repairs was relatively low compared to the number of umbilical repairs. The epigastric hernia repairs were performed mostly without mesh, contrary to umbilical hernia repairs where almost half of the procedures were with a mesh, thus precluding statistical comparison between surgical groups (open and laparoscopic repair, mesh and no mesh,

umbilical and epigastric hernias) in the present study. However, our data does not suggest a major difference in outcome following laparoscopic rather than open repair, umbilical rather than epigastric hernia repair, mesh or no mesh repair, although the overall complication rate in the laparoscopic group is twice that in the open group, and the length of hospital stay and readmission tended to be higher after a laparoscopic repair. The data may, however, be biased by factors like patient selection, surgical expertise, etc.

Recent studies from optimized fast-track surgical programs with a planned hospital stay of 2–4 days for medium and major surgical procedures such as colonic resection [15–18] gastric resection [19], and nephrectomy [20] found readmission rates between 6 and 11%. Taking into consideration that umbilical and epigastric hernia repair is often a minor surgical procedure, the present result of 5% readmission rate is not satisfactory. However, in comparison, nationwide results on early outcomes after incisional hernia repair, which is regarded as a larger and more complex surgical procedure irrespective of the surgical method (laparoscopic or open approach) [14, 21] are indeed worse [14]. Thus, the rates of readmission, and the morbidity and mortality rates after incisional hernia repair were 11%, 11% and 0.4% [14], respectively, compared with 5%, 4% and 0.1%, as found in the present study and in other studies [1].

The NPR system does not provide information on comorbidity, the size of the hernia defect, or individual surgical expertise. Discrimination between results after open and laparoscopic incisional repair might have suffered from selection bias owing to differences in these factors. However, the overall results on morbidity and mortality in the present study were comparable with those in the literature [1].

In order to improve outcome after ventral hernia repair, and inspired by quality assessment studies in inguinal hernia repair [2, 3, 5, 8], the Danish Ventral Hernia Database was recently launched to facilitate identification of surgical technical problems and contribute to improved outcomes [7]. Preliminary data from the Danish Ventral Hernia Database have shown large variation in almost all aspects of surgical approaches to ventral hernia repair, and the evidence for choice of surgical technique in ventral hernia treatment is poor [5]. Therefore, and on the basis of a recent national consensus meeting, agreement on a national strategy to reduce the many variations in the treatment strategies for ventral hernia surgery in Denmark has been proposed in order to facilitate better interpretation of future outcomes and to provide future evidence on perioperative risk factors for outcome after ventral hernia repair. [6]. Since 2007, the Danish Ventral Hernia Database has provided online web-based registration, including data on hernia size, surgical technique for repair and several other perioperative data [7].

In conclusion, early outcome after elective primary umbilical and epigastric repair is satisfactory in terms of low morbidity and mortality, but wound problems, seroma formation, and pain may lead to readmission and should be addressed in future outcome studies.

**Conflicts of interest** Regarding the present study all authors declares no conflict of interest.

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