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Intestinal obstruction after inguinal and femoral hernia repair: a study of 33,275 operations during 1992–2000 in Sweden

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Abstract The risk of intra-abdominal intestinal obstruction after open or laparoscopic hernioplasty is, to our knowledge, not known. The transabdominal laparoscopic (TAPP) route brings a potential risk of abdominal adhesions, which may increase the risk of postoperative intestinal obstruction. The pre-peritoneal route laparoscopically, totally extraperitoneal laparoscopic hernioplasty (TEP), should not increase this risk since the abdominal cavity is not entered. The Swedish Hernia Register, with 33,275 patients operated on for single primary unilateral groin hernia during the period 1992–2000, was linked to the Swedish Inpatient register and the Swedish Death register for the period 1987–2000. The risk of postoperative intestinal obstruction was low, 1.02 per 1,000 person-years. The highest adjusted relative risks (RR) were found in patients with previous admissions for abdominal inflammations or operations. The risk increased with the number of admissions. After an acute operation, and in patients older than 60 years, there was also a significantly increased risk. The RR was 2.79 (95% CI 1.01–7.42) after TAPP and 0.57 (95% CI 0.07–4.33) following TEP compared to patients operated on by the Lichtenstein method. None of the patients undergoing open hernia operations had a significantly increased risk. TAPP increased the risk of postoperative intestinal obstruction, but other risk factors, especially

previous abdominal surgery or inflammation, have greater influence.

Keywords Complications · Inguinal hernia · Intestinal obstruction · Laparoscopy · Register study

Introduction

Hernias of the groin—inguinal or femoral—are common in surgical practice and may bring a risk of incarceration of abdominal contents [1]. To avoid this complication, the surgical tradition is to operate on most patients with hernias. In Sweden (population 8.9 million) the incidence of hernia surgery in patients older than 15 years is about 200 operations per 100,000 inhabitants per year [2].

Many methods have been used with different kinds of sutured repairs, and many types of open or laparoscopic tension-free repair by mesh, with various results [3, 4]. Operations with mesh are now standard procedures in Sweden and Denmark [5, 6] and are found to be superior to repair without mesh, with shorter convalescence and lower risk of recurrence and pain [7].

When laparoscopic hernioplasty was introduced as an alternative to the open procedures, it was mainly performed by a pre-peritoneal placement of the mesh with a transabdominal technique (transabdominal pre-peritoneal, TAPP) [8]. An alternative technique, though more technically demanding, is totally extraperitoneal hernioplasty (TEP), which enables a pre-peritoneal repair without entering the abdominal cavity [8].

Serious complications such as vascular injuries, bowel injuries or intestinal obstruction are rare in groin hernia surgery. In a recent meta-analysis of 34 randomized trials of laparoscopic and open herniorrhaphies with 6,804 patients, complications were still rare, but more common at laparoscopic than at open repair. There were 4.7 potentially serious visceral or vascular complications per 1,000 operations in the laparoscopic group,

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including two patients with postoperative intestinal obstruction, and 1.1 per 1,000 operations in the open group. All complications in the laparoscopic group occurred after TAPP operations [3].

Since the peritoneal cavity is entered during TAPP there is a potential risk of postoperative intestinal obstruction due to adhesions or incarcerations in the trocar incisions [9]. In TEP, the peritoneal cavity is not entered and the risk of intra-abdominal intestinal obstruction is presumably the same as after open herniorrhaphy. However, there have been case reports describing intestinal obstruction after TEP where a peritoneal tear may be the cause of an incarceration [10, 11].

The risk of intra-abdominal intestinal obstruction after open herniorrhaphy is, to our knowledge, not known. We have not found any study of hernia repair reporting the risk of intestinal obstruction based on complete national data of preoperative risk factors, comprehensive follow-up of postoperative admissions, and also considering mortality.

The aim of this study was to analyze the risk of intestinal obstruction at hernia repair by surgical method by using data from three national registers, the Swedish Hernia Register (SHR), the Inpatient Register (IR) and the Swedish Death register.

Material and methods

The Swedish Hernia Register (SHR) was established in the year 1992 [2]. Operations of groin hernias are prospectively documented by a protocol including patient characteristics, mode of admission, time on waiting list, type of hernia as defined during surgery, methods of repair, anesthesia, length of stay, complications within 1 month, re-operation for recurrence, and personal identification number. The personal identification number enables follow-up of the patients nationwide, even if they move. External reviews with site visits to hospitals to compare register data with SHR patient records are performed annually [2, 6]. Initially eight hospitals contributed, but now the majority of the Swedish surgical units have joined the SHR.

Since 1987, the Swedish National Board of Health and Welfare has compiled data on all hospital discharges in the Inpatient Register (IPR). In addition to a personal identification number (uniquely identifying every resident of Sweden), each record contains medical data, including surgical procedures performed (coded according to the Swedish Classification of Operation and Major Procedures) and diagnoses at discharge (coded through 1996 according to the International Classification of Diseases, 9th revision, ICD9, according to the 10th revision, ICD10, thereafter).

Patients with a primary unilateral inguinal or femoral hernia with only one operation recorded in the SHR during the years 1992–2000 (the index operation, $n = 33,275$) were linked to the IR during the years

1987–2000 to identify preoperative and postoperative admissions.

Other risk factors than hernia surgery per se may be of a greater importance for the development of postoperative intestinal obstruction [12, 13]. Hence, the procedure codes for operations where the abdominal cavity was entered and/or the primary diagnoses indicating inflammatory diseases in the intra-abdominal or retro-peritoneal organs were compiled. Incarcerated hernias were not included. Intestinal obstruction was defined by ICD9 and ICD10 diagnoses and/or procedure codes for intestinal obstruction.

Finally, to ascertain complete follow-up of readmissions after hernia repair and mortality, all patients were linked to the Swedish Death Register. Follow-up started on the day of discharge after the index operation and ended on the date of the first readmission for intestinal obstruction, or operation, the date of death or 31 December 2000, whichever came first.

The 33,275 patients operated on for hernia repair were matched to the IPR. Among these, 2,294 patients had been admitted before, and 255 patients were admitted for intestinal obstruction. The study endpoint was admission for postoperative intestinal obstruction and 114 patients had been admitted for this. Among these, 24 patients had undergone abdominal surgery between the hernia operation and the later admission for intestinal obstruction. These patients were excluded from the analysis since the interceding operations were estimated to be a more important risk than the hernia operation [12, 13]. The final analysis was performed on 90 patients: 58 patients with a primary diagnosis of intestinal obstruction and 32 patients with intestinal obstruction procedure codes (Fig. 1).

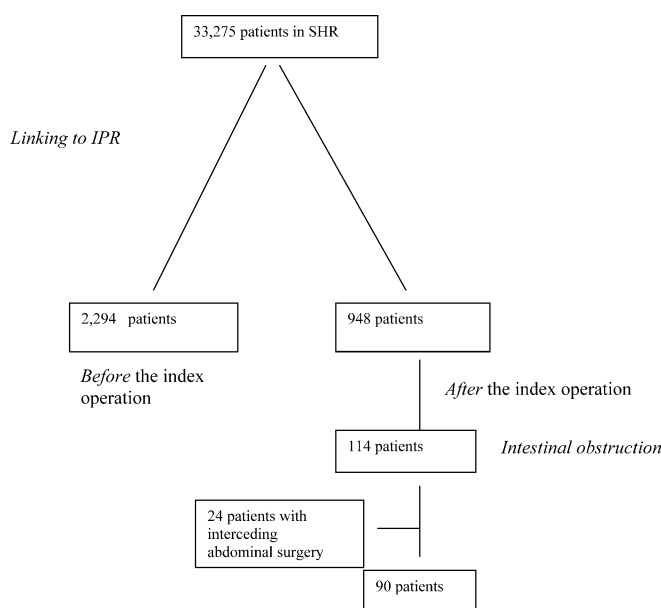


Fig. 1 Intestinal obstruction after hernia surgery. Illustration of the study population

The study was approved by the ethical committee of the Karolinska Institutet.

Statistical methods

To take the varying duration of follow-up for patients in the study into account, univariate and multivariate Cox regression analyses were performed to estimate and compare unadjusted and adjusted relative risks for an intestinal obstruction after a hernia repair. A 95% confidence interval for the relative risk was calculated and a *p*-value below 0.05 was considered statistically significant.

Results

The SHR study cohort consisted of 33,275 patients. Baseline characteristics are given in Table 1. The median age was 60 years (QR 48–71). The patients were followed median 11.7 years (range 5–14) before the hernia operation and median 2.1 years (range 0–9.1) after the hernia operation (Table 1).

In all, 90 patients developed intestinal obstruction or 1.02 per 1,000 personyears (Table 2). The risk following a Lichtenstein operation was 1.05 per 1,000 personyears, 1.14 after a TAPP and 0.28 after TEP, respectively.

During the index admission two patients died of intestinal obstruction and were subsequently excluded. During follow-up of the 90 patients with intestinal obstruction, another two patients died from intestinal

Table 1 Intestinal obstruction after hernia surgery. Characteristics of the study base (*n* = 33,275 patients)

	<i>n</i>	(%)
Gender		
Male	30,385	(91)
Female	2,890	(9)
Age		
15–47	8,141	(25)
48–59	8,311	(25)
60–71	8,079	(24)
72–	8,744	(26)
Type of hernia		
Indirect	19,698	(59)
Direct	9,729	(29)
Femoral	882	(3)
Other	2,966	(9)
Acute or planned operation		
Planned	31,263	(94)
Acute	2,012	(6)
Operation method		
Shouldice	7,778	(23)
Inguinal mesh	1,867	(6)
TAPP	1,157	(3)
Lichtenstein	9,826	(30)
Meshplug	4,570	(14)
TEP	1,357	(4)
Other	6,720	(20)

Table 2 Intestinal obstruction after hernia surgery. Characteristics of patients with intestinal obstruction (*n* = 90)

	Intestinal obstruction			
	Diagnosis	Operation	Total	Risk/1,000 personyears
Gender				
Male	47	23	70	0.87
Female	11	9	20	2.52
Age				
15–47	4	2	6	0.25
48–59	9	3	12	0.55
60–71	11	10	21	0.97
72–	34	17	51	2.37
Type of hernia				
Indirect	28	20	48	0.90
Direct	12	6	18	0.73
Femoral	8	3	11	4.69
Other	10	3	13	1.55
Acute or planned operation				
Planned	46	24	70	0.83
Acute	12	8	20	4.36
Operation method				
Shouldice	13	14	27	1.01
Inguinal mesh	0	1	1	0.22
TAPP	3	3	6	1.14
Lichtenstein	14	2	16	1.05
Meshplug	5	2	7	0.87
TEP	0	1	1	0.28
Other	23	9	32	1.28

obstruction. The crude mortality within 30 days after the hernia operation was 99 in 33,275 (0.3%) patients.

Significant risk factors for postoperative intestinal obstruction in the univariate Cox analyses (Table 3) were female sex, previous admissions, age above 60 years, acute operation, index operation combined with other surgery at the index admission, femoral hernia or other hernia. There were no statistically significant differences between the different types of hernia operations in the univariate analysis.

Considering all risk factors combined in a multivariate Cox analysis (Table 4), most risk factors were still significant. The risk almost doubled by each age group. In women, the risk was still higher than in men, although not significantly. An acute operation more than doubled the risk. Earlier admissions markedly increased risks, particularly in patients with several admissions and a history of intestinal obstruction. The relative risk of intestinal obstruction was significantly higher with TAPP (2.79, 95% CI 1.01–7.42) than with the any other type of operation, while TEP did not bring an increased risk (Fig. 2).

Discussion

The main finding of our study was that the risk of an intestinal obstruction after an operation of groin hernia was low. The risk increased with age, after an acute operation, and markedly when the patients had been previously admitted, particularly for intestinal

Table 3 Intestinal obstruction after hernia surgery ($n = 33,275$). Univariate Cox-analysis

	Hernia operations	Intestinal obstruction		Relative risk	95% confidence interval	
	<i>n</i>	<i>n</i>	%		Lower	Upper
Gender						
Male	30,385	70	0.23	1.00	ref	ref
Female	2,980	20	0.69	2.94	1.79	4.83
Age						
15–47	8,141	6	0.07	1.00	ref	ref
58–59	8,311	12	0.14	2.10	0.79	5.60
60–71	8,079	21	0.26	3.71	1.50	9.20
72–	8,743	51	0.58	8.87	3.81	20.68
Type of hernia						
Direct	9,729	18	0.19	1.00	ref	ref
Femoral	882	11	1.25	6.62	3.13	14.02
Other	2,966	13	0.44	2.23	1.01	4.55
Indirect	19,698	48	0.24	1.28	0.74	2.20
Acute or planned operation						
Planned	31,263	70	0.22	1.00	ref	ref
Acute	2,012	20	0.99	5.03	3.06	8.27
Operation method						
Lichtenstein	9,826	16	0.16	1.00	ref	ref
Shouldice	7,778	27	0.35	1.32	0.70	2.48
Inguinal mesh	1,867	1	0.05	0.26	0.03	1.94
Meshplug	4,570	7	0.15	0.86	0.35	2.09
TEP	1,357	1	0.07	0.32	0.04	2.44
TAPP	1,157	6	0.52	1.63	0.63	4.23
Other	6,720	32	0.48	1.74	0.94	3.22
Index operation						
Hernia only	32,670	77	0.23	1.00	ref	ref
Hernia + intestinal obstruction	63	1	1.59	8.78	1.22	63.16
Hernia + other diagnosis	542	12	2.21	10.35	5.63	19.01
Previous admission						
No previous admissions	30,981	62	0.2	1.00	ref	ref
One admission without intestinal obstruction	1,861	13	0.7	3.91	2.15	7.11
One admission with intestinal obstruction	88	1	1.14	6.58	0.91	47.44
> 1 admission no intestinal obstruction	259	5	1.93	11.30	4.54	28.12
> 1 admission + intestinal obstruction	86	9	10.47	68.79	34.12	138.68

obstruction. The risk was higher after a TAPP operation but not after a TEP operation.

The most important risk factor was earlier hospital admissions, particularly multiple admissions and operations, including earlier events with intestinal obstruction. These relative risks were the highest found in our study, suggesting that the most important risk factor for postoperative intestinal obstruction is a previous history of abdominal surgery or inflammation. This finding confirms clinical experience and further supports the importance of obtaining a detailed patient history before considering surgery. The risk increased if the patient was older than 60 years, or if the index operation was acute rather than elective. No other operation method but TAPP brought a significantly increased risk. The increased risk after TAPP is, however, moderate compared with other risk factors.

Female patients first appeared to be at higher risk in the univariate Cox analysis, particularly if they had femoral hernia or other types of hernias. However, this was not significant in the multivariate analysis, indicating that these factors do not contribute to the risk of

developing intestinal obstruction. No type of hernia operation brought an increased risk in the univariate analysis compared to the Lichtenstein reference method.

However, the risk following a TAPP operation was significantly increased in the multivariate Cox analysis. Yet, this risk estimate was lower than all other significant risk factors, except patients undergoing an acute hernia operation. This indicates that other factors than the operation method for hernia repair may be more important for the risk of postoperative intestinal obstruction. Previous laparotomies have been reported to predispose for later intra-abdominal adhesions and intestinal obstruction [12], which is in accordance with our findings, where previous admissions was the single most important risk factor.

Laparoscopic surgery is associated with fewer adhesions postoperatively than open operations [14]. In an experimental study, the authors showed that open herniorrhaphy was associated with fewer intraperitoneal adhesions than TAPP operations [15]. The proportion of intestinal obstruction after laparoscopic surgery in a retrospective study of 10,327 patients was 0.11–2.5%

Table 4 Intestinal obstruction after hernia surgery ($n = 33,275$). Multivariate Cox analysis

	Hernia operations	Intestinal obstruction		Relative risk	95% confidence interval	
	<i>n</i>	<i>n</i>	%		Low	High
Gender						
Male	30,385	70	0.23	1.00	ref	ref
Female	2,980	20	0.69	1.42	0.76	2.65
Age						
15–47	8,141	6	0.07	1.00	ref	ref
48–59	8,311	12	0.14	2.40	0.90	6.41
60–71	8,079	21	0.26	4.40	1.62	10.08
72–	8,743	51	0.58	7.38	3.12	17.48
Type of hernia						
Direct	9,729	18	0.19	1.00	ref	ref
Femoral	882	11	1.25	2.21	0.85	5.72
Other	2,966	13	0.44	1.90	0.93	3.9
Indirect	19,698	48	0.24	1.27	0.74	2.19
Acute or planned operation						
Planned	31,263	70	0.22	1.00	ref	ref
Acute	2,012	20	0.99	2.16	1.16	4.03
Operation method						
Lichtenstein	9,826	16	0.16	1.00	ref	ref
Shouldice	7,778	27	0.35	1.46	0.77	2.75
Inguinal mesh	1,867	1	0.05	0.23	0.03	1.73
Meshplug	4,570	7	0.15	0.91	0.37	2.22
TEP	1,357	1	0.07	0.57	0.07	4.33
TAPP	1,157	6	0.52	2.79	1.01	7.42
Other	6,720	32	0.48	1.13	0.58	2.18
Index operation						
Hernia only	32,670	77	0.23	1.00	ref	ref
Hernia + intestinal obstruction	63	1	1.59	0.51	0.06	4.17
Hernia + other diagnosis	542	12	2.21	3.70	1.81	7.55
Previous admission						
No previous admissions	30,981	62	0.2	1.00	ref	ref
One admission without intestinal obstruction	1,861	13	0.7	3.60	1.97	6.56
One admission with intestinal obstruction	88	1	1.14	4.27	0.59	31.18
> 1 admission no intestinal obstruction	259	5	1.93	11.01	4.37	27.72
> 1 admission + intestinal obstruction	86	9	10.47	58.99	28.34	122.79

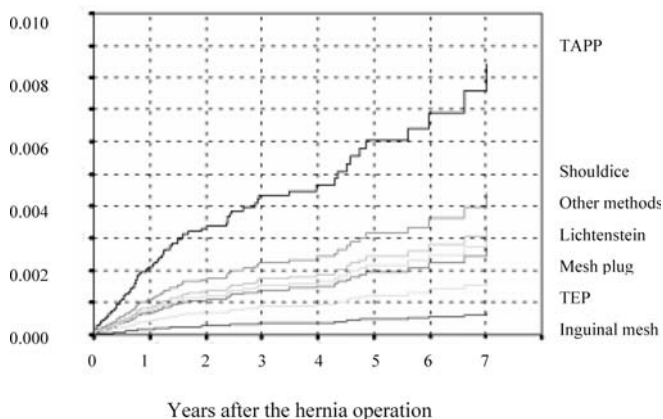


Fig. 2 Intestinal obstruction after hernia surgery. Cumulated risk of intestinal obstruction after an operation of a primary unilateral inguinal or femoral hernia. Multivariate analysis including sex, age, type of hernias, acute or planned operation, operation method, diagnosis at index operation and previous admissions

[16] with the highest risk after a TAPP operation and the lowest after laparoscopic cholecystectomy. The risk reported in that study was higher than we found after TAPP. In a study of the risk of intestinal obstruction after appendectomy, the control group had an accumulated risk of being operated on for intestinal obstruction of 0.003% after 1 year and 0.06% after 10 years [17], which is lower than our results.

The Swedish National Inpatient Register has a complete set of data on all admissions and a high validity [18]. Follow-up of mortality in Sweden is also almost complete [19]. The Swedish Hernia Register is validated regularly [2, 6] and now includes the majority of the groin hernia operations in Sweden. By combining these large national registries we believe that our results give valid estimates of the postoperative risk of intestinal obstruction after hernia repair. We feel that it is important to include all hernia operations in a national register and we recommend regular linking to the national patient register to monitor the outcome of hernia surgery.

The risk of intestinal obstruction might, however, be a high estimate since it was not possible to validate each individual patient record. Typically, validation of register data might lead to loss of observations. On the other hand, many patients who seek medical attention for postoperative non-specific abdominal pain are examined and monitored in an ambulatory care setting, while the patients in our study had actually been admitted or operated on for intestinal obstruction. Our findings might be a conservative estimate of the underlying risk since the SHR, which includes patients operated on in both day surgery as well as those hospitalized, was started gradually over the course of several years. However, it is not possible to perform this study within the Inpatient Register since this includes only admitted patients.

The risk of postoperative intestinal obstruction was low and pre-peritoneal laparoscopic hernioplasty (TEP) did not bring an increased risk of postoperative intestinal obstruction. Transabdominal laparoscopic hernioplasty (TAPP) increased this risk. However, other risk factors, especially previous abdominal surgery or inflammations, are more important, confirming the importance of a thorough patient history.

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