Risk Factors for Long-term Pain After Hernia Surgery

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Objective: To estimate the prevalence of residual pain 2 to 3 years after hernia surgery, to identify factors associated with its occurrence, and to assess the consequences for the patient.

Summary Background Data: Iatrogenic chronic pain is a neglected problem that may totally annul the benefits from hernia repair.

Methods: From the population-based Swedish Hernia Register 3000 patients aged 15 to 85 years were sampled from the 9280 patients registered as having undergone a primary groin hernia operation in the year 2000. Of these, the 2853 patients still alive in 2003 were requested to fill in a postal questionnaire.

Results: After 2 reminders, 2456 patients (86%), 2299 men and 157 women responded. In response to a question about "worst perceived pain last week," 758 patients (31%) reported pain to some extent. In 144 cases (6%), the pain interfered with daily activities. Age below median, a high level of pain before the operation, and occurrence of any postoperative complication were found to significantly and independently predict long-term pain in multivariate logistic analysis when "worst pain last week" was used as outcome variable. The same variables, along with a repair technique using anterior approach, were found to predict long-term pain with "pain right now" as outcome variable.

Conclusion: Pain that is at least partly disabling appears to occur more often than recurrences. The prevalence of long-term pain can be reduced by preventing postoperative complications. The impact of repair technique on the risk of long-term pain shown in our study should be further assessed in randomized controlled trials.

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Until recently, research on the results of hernia surgery has focused mainly on recurrences. However, with the introduction of mesh techniques and presumably an increased awareness of the importance of systematic quality control, the recurrence rate has decreased dramatically.[1] Hence, now that recurrences are no longer a pressing clinical problem, there has been a recent upsurge in interest in chronic pain as an adverse outcome. But the level of quantification of pain has often been limited in studies addressing the risk of long-term pain, and pain has sometimes been treated merely as a dichotomous (yes/no) phenomenon.[2] As a result, the clinical and public health significance of reported prevalence rates of residual pain (ranging between 0% and 37%) remains uncertain.[3]

With the main purpose of evaluating long-term pain as an alternative endpoint in research on the outcome of hernia surgery, we used a validated pain questionnaire to investigate pain behavior rather than imaginary descriptors of pain intensity in an essentially population-based series of patients operated on 59 hospitals.

MATERIALS AND METHODS

In the Swedish Hernia Register (SHR),[4] detailed information on more than 100,000 groin hernia repairs has been compiled since 1992. Every inguinal or femoral hernia operation in patients of ages 15 years or older at participating departments are recorded according to a standardized protocol. Recorded variables include age, gender, mode of admission, time on waiting list, type of hernia as noted during operation, size of the defect, method of repair, postoperative complications and reoperation for recurrence.[4] Methods of repair using anterior approach include Liechtenstein, Shouldice, Bassini, plug procedures, and other methods through groin incision. Methods of repair using posterior approach include laparoscopic, Stoppa, and Nyhus techniques. Information on clinical follow-up is not mandatory, but any complication observed by the operating unit up to 30 days after surgery has to be recorded in the database.[5] Every Swedish resident has a unique National Registration Number that is universally used in official contexts, including entries in population and health registers, as well as in medical case records. The National Registration Number makes follow-up possible through cross-linkages within the SHR and also through record linkages to the Swedish Cause of Death Register (CDR) and the continuously updated and virtually complete national Inpatient Register.

Patients

Between January 1 and December 31, 2000, 10,479 hernia operations at 59 hospitals, constituting 60% of all operating units in Sweden, were recorded in the SHR. Of these, 9280 were primary hernia repairs. After exclusion of

patients with bilateral repairs, previous hernia operations on the contralateral side (served as reference for pain), subsequent hernia operations on either side, and patients below 15 years or above 85 years of age, 7828 patients were eligible for investigation. By cross-linkage with CDR (May 2002), 7536 patients were found to be still alive. From this cohort, we randomly selected 3000 patients who had undergone a unilateral repair of a primary inguinal or femoral hernia.

There were 2787 (92.9%) men and 213 (7.1%) women in the sample, with a mean age of 58.2 years. Before the questionnaires were mailed, a final record linkage with the CDR was performed in January 2003, and this revealed that 147 of these patients had died, leaving 2853 still alive and available for contact (Table 1). These patients received a postal questionnaire about the occurrence and daily life consequences of inguinal pain before and after the operation. Two reminding letters were sent after 5 and 10 weeks, respectively, to those who had not responded.

Questionnaire

The self-recording instrument used in the questionnaire was a 7-step fixed point scale with steps operationally linked to behavioral events, including additional monitoring of pain duration, termed the "duration-intensity-behavior-scale" (DIBS). The DIBS scale has previously been evaluated regarding compliance, authenticity, reliability, and sensitivity among patients with functional abdominal pain.[6] By defining pain operationally in terms of behavior necessitated by the pain, the DIBS instrument escapes, at least to some extent, the dilemma of pain definition and standardization, and the impact on daily life activities is easily inferred. Pain in the contralateral (thus not operated) groin was used as a reference. The entire questionnaire has also recently been validated (submitted manuscript) and found to have high validity and reliability as an instrument for measuring chronic pain following hernia surgery. The validation also included a comparison between the operated and contralateral groin.

TABLE 1. The Process of Patient Selection for the Study

No. of Patients	Patient Selection
10,479	No. of operations recorded in the SHR between January 1 and December 31, 2000
9280	After exclusion of 1199 recurrent hernias (December 31, 2001)
7828	After exclusion of 1452 bilateral operations or previous operations on contralateral side
7536	Remained eligible for the study after exclusion of 283 patients by cross-linkage with CDR (May 2002) and 9 patients older than 85 years
3000	No. of patients selected for the study January 2003
2853	Cross-linkage with CDR January 2003 before questionnaires were finally posted; another 147 patients excluded; this is the number of patients who ultimately were sent a questionnaire
2456	No. of patients who responded to the questionnaire

Selection criteria were primary unilateral inguinal or femoral hernia operations in patients 15 to 85 years of age without previous or subsequent (up to Dec 31, 2001) inguinal hernia operations.

There was a baseline level of pain in the contralateral groin, but the level of pain was significantly higher in the operated groin.

Statistical Methods

Age-specific prevalence of pain in 10-year age strata at the time of the questionnaire survey was expressed as the number of patients with answers fulfilling our criteria of persistent pain, divided by the total number of patients who gave interpretable answers in the respective age stratum. We calculated 95% confidence intervals (CI) according to the method proposed by Wilson.[7]

Factors associated with residual pain were determined in multivariate unconditional logistic regression models, with the following independent variables: age in quartiles based on the distribution among subjects with no pain, sex, hernia reducibility on admission (yes/no), type of hernia (lateral, medial, femoral, or combined), size of the defect ($>$/$\leq$3 cm), level of pain before the operation ($\geq$/$<$ "interferes with concentration on chores and activities"), method of repair (Shouldice, Lichtenstein, Plug techniques, other open mesh techniques, open preperitoneal mesh techniques, other open mesh techniques, Trans Abdominal Pre Peritoneal laparoscopic repair [TAPP] and Total Extra Peritoneal laparoscopic repair[TEP]), techniques not involving exploration of the groin grouped together (TEP, TAPP, and open preperitoneal mesh techniques), recorded postoperative complications (yes/no), hernia surgery volume at the hospital ($\geq$/$<$200 operations per year), and number of surgeons who performed the operation (1 or 2). The dependent variable was log $(p/1 - p)$, where p was the probability of having any pain (ie, "pain present but can easily be ignored" or more). Separate models were built for "pain right now" and "worst pain last week." The models were constructed by stepwise selection with entry testing based on the significance of the score statistic, and removal testing based on the likelihood-ratio statistic.

Severe acute postoperative pain is also recorded in the register as a postoperative complication but was not included in the analysis of risk factors for long-term pain since the distinction between acute and chronic postoperative pain is not clear enough to define them as independent and dependent variables in the same multivariate model, ie, acute pain could be considered as part of the causal chain between the operative procedure and the development of chronic pain.

RESULTS

The distribution of answers is presented in Table 2. After 2 reminders, 2456 (86%) of the 2853 patients had responded (2299 men and 157 women). Their mean age at operation was 58.2 years. Reasons for not returning the questionnaire were unknown address in 32 (1%) and failure to respond in the other 365 (13%). There was no difference in age or in proportion of patients with complications or severe postoperative pain recorded in the SHR between patients who responded and those who did not. Postoperative complications included wound infections (n = 34, 1.4%), hematoma (n = 111, 4.4%), severe pain (n = 30, 1.2%), and other (n = 71, 2.9%). Postoperative complications are defined according to the standards of the SHR.[4] The proportions of patients with

TABLE 2. Questionnaire and Results

	No Pain	Pain Present but Can Easily Be Ignored	Pain Present, Cannot Be Ignored, but Does Not Interfere With Everyday Activities	Pain Present, Cannot Be Ignored, Interferes With Concentration on Chores and Daily Activities	Pain Present, Cannot Be Ignored, Interferes With Most Activities	Pain Present, Cannot Be Ignored, Necessitates Bed Rest	Pain Present, Cannot Be Ignored, Prompt Medical Advice Sought	Missing
Estimate the severity of pain in the groin you felt before the operation	300 (12.2)	391 (15.9)	480 (19.5)	682 (27.8)	326 (13.3)	82 (3.3)	130 (5.3)	65 (2.6)
Estimate the pain you feel right now in the groin on the same side as the operation	1731 (70.5)	387 (15.8)	175 (7.1)	74 (3.0)	15 (2.0)	2 (0.1)	6 (0.2)	66 (2.7)
Estimate the worst pain you felt in the operated groin during this past week	1608 (65.5)	424 (17.3)	190 (7.7)	94 (3.8)	29 (1.2)	11 (0.4)	10 (0.4)	90 (3.6)
If you answered "no pain" to question 4, try to remember when the pain in the operated groin disappeared after the operation	The pain in the operated groin disappeared within 1 mo after the operation; 966 (39.3)	The pain in the operated groin disappeared 2–3 mo after the operation; 440 (17.9)	The pain in the operated groin disappeared 4–6 mo after the operation; 127 (5.1)	The pain in the operated groin disappeared 7–12 mo after the operation; 73 (3.0)	The pain in the operated groin disappeared 13–24 mo after the operation; 59 (2.4)	The pain in the operated groin disappeared recently; 5 (0.2)	Missing; 786 (32.0)	
How often have you felt pain in the operated groin during the past week?	Once a week; 243 (9.9)	2–5 times a week; 222 (9.0)	Every day; 112 (4.6)	Every day and even during night time; 25 (1.0)	I have had pain the whole week, day as well as night; 16 (0.7)	Missing; 107 (4.4)		
How long have the episodes of pain lasted in the past week?	1 min–1 h; 375 (15.3)	1–5 h; 115 (4.7)	The whole day; 70 (2.9)	Day and night; 15 (0.6)	The pain has lasted the whole week, day and night; 13 (0.5)	Missing; 137 (5.6)		
Do you find it difficult getting up from a low chair because of pain in the operated groin?	No; 2083 (84.8)	Yes; 82 (3.3)	I don't know; 54 (2.2)	Not applicable; 19 (0.8)	Missing; 218 (8.9)			
Do you find it difficult sitting down for more than half an hour because of the pain?	2097 (85.4)	94 (3.8)	31 (1.3)	9 (0.4)	225 (9.2)			

(Continued)

TABLE 2. (*Continued*)

|	No Pain	Pain Present but Can Easily Be Ignored	Pain Present, Cannot, but Does Not Interfere With Everyday Activities	Pain Present, Cannot Be Ignored, Interferes With Concentration on Chores and Daily Activities	Pain Present, Cannot Be Ignored, Interferes With Most Activities	Pain Present, Cannot Be Ignored, Necessitates Bed Rest	Pain Present, Cannot Be Ignored, Prompt Medical Advice Sought	Missing
Do you find it difficult standing up for more than half an hour because of the pain?	2060 (83.9)	119 (4.8)	36 (1.5)	17 (0.7)	224 (9.1)			
Do you find it difficult going up or down stairs because of the pain?	2082 (84.8)	119 (4.8)	26 (1.1)	8 (0.3)	221 (9.0)			
Does driving a car cause you pain?	2111 (86.0)	42 (1.7)	9 (0.4)	66 (2.7)	228 (9.3)			
Has the pain limited your ability to exercise and perform sports?	1783 (72.6)	193 (7.9)	72 (2.9)	178 (7.2)	230 (9.4)			
Have you on any occasion taken pain-killers for pain in the operated groin?	No 2178 (88.7)	Yes 56 (2.3)	Missing 222 (9.0)					
To what extent has pain in the groin limited your working capability in the last 2 mo?	I have not needed to take sick leave 1917 (78.1)	The pain made me take 1–7 days sick leave during the last 2 mo 4 (0.2)	The pain made me take sick leave for 1–4 wk during the last 2 mo 3 (0.1)	The pain has made me take sick leave for the whole of the last 2 mo 7 (0.3)		I have a disability pension because of pain in the groin 6 (0.2)	I am not working 294 (12.0)	225 (9.2)
Estimate the severity of pain you feel right now in the groin opposite to the operated side	No pain 2074 (84.4)	Pain present but can easily be ignored 162 (6.6)	Pain present, cannot be ignored, but does not interfere with everyday activities 55 (2.2)	Pain present, cannot be ignored, interferes with concentration on chores and daily activities 29 (1.2)	Pain present, cannot be ignored, interferes with most activities 9 (0.4)	Pain present, cannot be ignored, necessitates bed rest 2 (0.1)	Pain present, cannot be ignored, prompt medical advice sought 4 (0.2)	121 (4.9)
Estimate the worst pain you have felt in the groin opposite to the operated side during this past week	1959 (79.8)	160 (6.5)	54 (2.2)	23 (0.9)	11 (0.4)	2 (0.1)	3 (0.1)	244 (9.9)
To be answered by males: have you experienced testicular pain on the same side as the operated groin since the operation?			No 1831 (79.6)	Yes 336 (14.6)		Missing 132 (5.7)		
Have you been operated on for hernia or had an abdominal operation since the hernia operation in 2000?			2189 (89.1)	154 (6.3)			113 (4.6)	

Values are no. ( ) of patients.
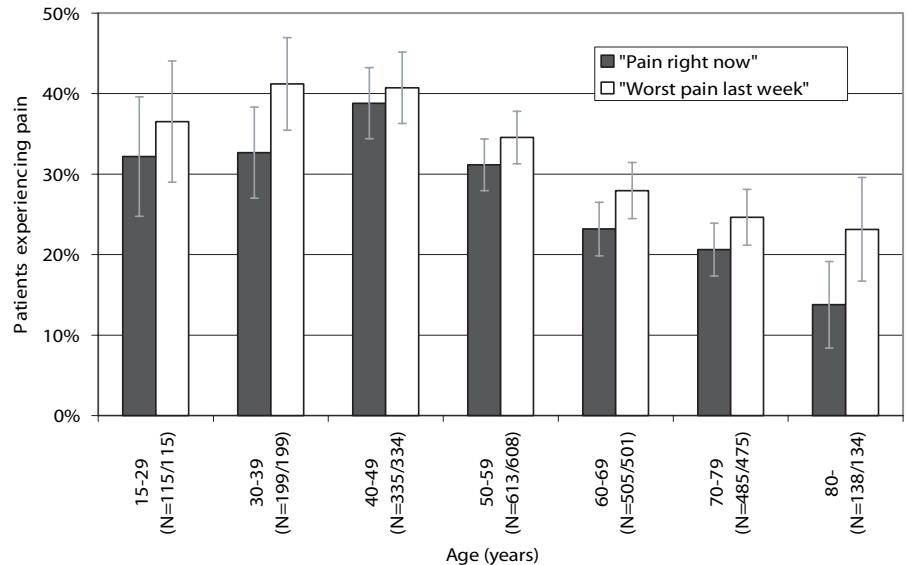
FIGURE 1. Prevalence of residual pain by age. Vertical bars indicate 95% confidence intervals. Numbers in brackets on the x-axis indicate number of responders to the 2 respective questions.

residual pain 24 to 36 months after the operation, stratified for age, technique of repair, type of hernia, size of hernia defect, level of pain before the operation, and postoperative complications are shown in Figures 1 and 2. Since some patients did not answer all questions, the numbers of patients are not identical for "pain right now" and "worst pain last week."

In answer to the question about "worst pain last week," 758 patients (31%; 95% confidence interval [CI], 29%–33%) reported some form of pain, whereas 144 (6%; 95% CI, 5%–7%) had had severe pain that could not be ignored and interfered with their daily activities. When asked to estimate the severity of pain before the operation, 2091 (85%) reported some form of pain and 1220 (50%) severe pain. There was no significant association in type of repair and level of preoperative pain in χ^2 analysis. In response to questions concerning daily activities, 82 (3.3%; 95% CI, 2.7%–4.1%) stated that it was difficult to get up from a low chair and 119 (4.8%; 95%

CI, 4.1%–5.8%) had difficulty in standing up for more than 30 minutes and climbing stairs. In 193 patients (7.9%; 95% CI, 6.9%–9.0%), the pain limited their ability to perform sports. Some period of sick-leave had to be taken by 20 patients (0.8%; 95% CI, 0.5%–1.3%) in the last 2 months and 6 patients (0.2%; 95% CI, 0.1%–0.5%) claimed to be receiving a disability pension for pain in the surgically treated groin. The number of patients still at work in the cohort was 1937 (79%) (Table 3).

In multivariate logistic analysis, a high level of pain before the operation (odds ratio [OR], 2.1; 95% CI, 1.8-2.6; $P < 0.001$) and postoperative complications (OR, 1.8; 95% CI, 1.2–2.5; $P = 0.003$) were found to significantly and independently predict residual pain, whereas "age above median" (OR, 0.7; 95% CI, 0.5–0.8; $P < 0.001$) predicted a decrease in residual pain when "worst pain last week" was used as the outcome variable. No specific technique of repair
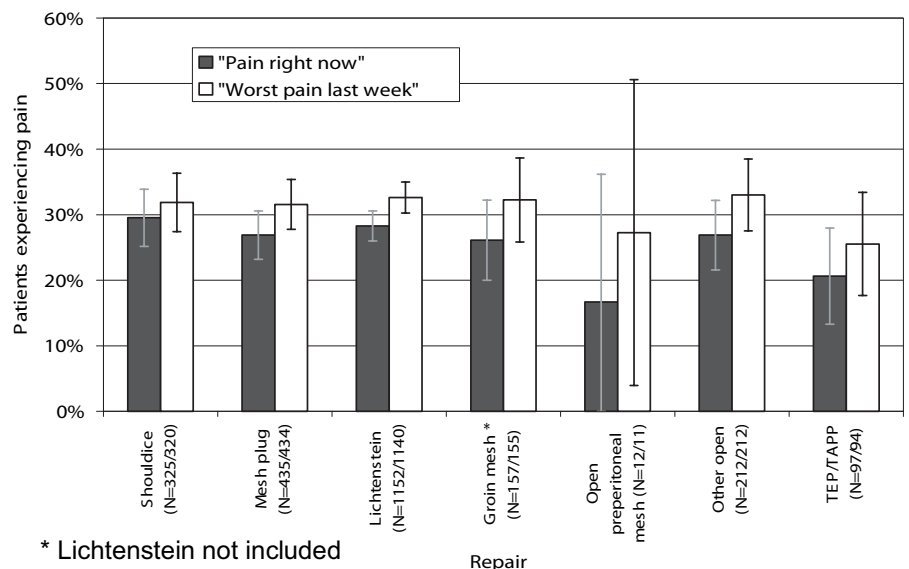

FIGURE 2. Prevalence of residual pain by technique of repair. Vertical bars indicate 95% confidence intervals. Numbers in brackets on the x-axis indicate number of responders to the 2 respective questions.

* Lichtenstein not included

TABLE 3. Results of Multivariate Logistic Analysis of Risk Factors Predicting Any Level of Pain Versus No Pain Regarding "Pain Right Now"

Factor	Patients Perceiving Pain (%)	Univariate Model		Final Multivariate Model*	
		OR	95% CI	OR	95% CI
Age					
Median ≤ 59 yr	345/1026 (33.6)	1	Reference	1	Reference
Median > 59 yr	205/976 (21.0)	0.55	0.45–0.68	0.54	0.44–0.66
No. of operations performed at the clinic per year					
<200	225/859 (26.2)	1	Reference		
≥200	325/1143 (28.4)	1.19	0.96–1.46		
Gender					
Male	517/1878 (27.5)	1	Reference		
Female	33/124 (26.6)	1.11	0.71–1.73		
Reducible versus nonreducible hernia					
Nonreducible	26/111 (23.4)	1	Reference		
Reducible	524/1891 (27.7)	1.15	0.72–1.86		
Hernia repair					
Anterior approach	532/1907 (27.9)	1	Reference	1	Reference
Posterior approach	18/95 (18.9)	0.58	0.34–0.99	0.56	0.33–0.95
Type of hernia					
Femoral	5/34 (14.7)	1	Reference		
Medial	171/602 (28.4)	2.90	1.02–8.25		
Lateral	340/1228 (27.7)	2.44	0.87–6.83		
Combined	34/138 (24.6)	2.47	0.82–7.48		
Diameter of hernia defect					
≤3 cm	422/1467 (28.8)	1	Reference		
>3 cm	128/535 (23.9)	0.81	0.63–1.05		
Level of pain before the operation					
Lower than "Affects concentration on daily activities"	176/966 (18.2)	1	Reference	1	Reference
"Affects concentration on daily activities" or higher	374/1036 (36.1)	2.49	2.02–3.08	2.43	1.97–2.99
Postoperative complication					
Not registered	498/1865 (26.7)	1	Reference	1	Reference
Registered	52/137 (38.0)	1.76	1.21–2.57	1.77	1.22–2.57
No. of surgeons performing the operation					
1	367/1380 (26.6)	1	Reference		
>1	183/622 (29.4)	1.10	0.88–1.37		

*Final model contains the variables with values in the OR column.

OR indicates odds ratio; CI, confidence interval. Stepwise selection method with entry testing based on the significance of the score statistic, and removal testing based on the probability of a likelihood-ratio statistic based on the maximum partial likelihood estimates. Since the analysis is based on 2002 patients with complete data for all variables, the percentages of patients perceiving pain differs slightly from that in the whole cohort.

was significantly associated with an increased or decreased risk of residual pain in either of the 2 multivariate analyses, but the number of patients with long-term pain was small in each category, thus prohibiting statistical ascertainment of anything but very marked relationships. When the techniques were grouped into those that did or did not involve dissection of the groin, however, the latter techniques were associated with a significantly lower risk of long-term pain with "pain right now" as outcome variable (OR, 0.6; $P = 0.033$). When

"worst pain last week" was used as the outcome variable, groin dissection was associated with a nonsignificant decrease of the risk for long-term pain.

DISCUSSION

Our results emphasize that residual pain should be viewed as an essential endpoint when investing the outcome of hernia surgery. After 24 to 36 months, nearly 30% of the

patients reported some form of pain or discomfort and close to 6% of all patients reported inguinal pain of such intensity that it disturbed their concentration in activities of daily life during the week preceding follow-up. By contrast, the 6-year cumulative incidence of reoperation for recurrence was reported to be 4.5%.[4] Furthermore, this pain caused social disability, interfering with such activities as walking, standing, and sitting in 11.3% to 14.2% of the surgically treated patients. The prevalence of long-term pain in this Swedish patient population conforms with the data reported by Bay-Nielsen and Poobalan[3,8] but differs substantially from the experience of Condon[9] who found that chronic pain occurred in less than 1%.

Of the variables that were independently associated with an increased risk of residual pain, ie, age, pain level before the operation, techniques involving anterior approach, and postoperative complications, only the operative technique and complications can potentially be controlled by the surgeon. Postoperative complications were found to be linked to an increased risk for long-term pain in our study. Others have not found this link.[10] In most studies, however,[3,8,11–15] complications do not seem to be evaluated at all in respect to residual pain. Our results indicate that postoperative complications may serve as an important intermediary variable,[16] useful in systematic improvement systems aimed to decrease the risk for long-term postherniorrhaphy pain. However, it must be emphasized that the reported associations in this observational study do not necessarily represent causal relationships. Although nobody would dispute the desirability of reducing postoperative complications, data from sufficiently large randomized clinical trials are needed to prove that such efforts would also reduce the risk of long-term pain.

Operations by posterior approach (ie, laparoscopic and open posterior operations) have, in or study, shown to cause less pain than operations by groin incision. Our study did not have sufficient power to detect clinically important advantages of specific repair methods. Hence, differences might well exist. When combined into one category, surgical techniques not involving dissection of the groin were associated with a lower prevalence of residual pain after 24 to 36 months, compared with techniques requiring groin dissection. In view of the ad hoc character of this analysis, however, cautious interpretation is recommended. The results from recent randomized clinical trials comparing laparoscopic TEP or TAPP repair with open tension free mesh repair are conflicting. Some trials resulted in a lower prevalence of postoperative pain in the laparoscopic group,[12,13,17] whereas others showed no difference between the treatment arms.[11,14] Our finding, if true, should further be weighed against a possibly increased risk of recurrence with such techniques, as indicated in some studies.[11,18]

In our study, a high level of preoperative pain indicated an increased risk of long-term pain, as reported also by Poobalan et al[8] and Courtney et al.[15] This might suggest that the hernia disease was already complicated prior to surgery in some patients; stretching, entrapment, and/or inflammation of local nerves are conceivable mechanisms, but psychologic susceptibility or increased pain sensitivity may also play a

role. Moreover, the pain prior to the operation may also have originated from other conditions than the hernia, and will then persist after the operation. A third possibility is that interindividual variations in the manner of communicating subjective feelings may have affected the observed relationship. A general inclination to report pain and other feelings in an exaggerated way will most likely persist both before and after the operation and so will a propensity for being stoical. However, a cautious interpretation of these results is needed since the answer to the question of preoperative pain is the patient's recollection of the pain level. The complexity of inguinal pain is underlined by the fact that a substantial proportion of patients also reported pain from the nontreated contralateral groin. Randomized intervention studies are required to answer the question whether special preoperative investigations and/or tailored management, for instance specially adapted analgesia and anesthesia or particularly atraumatic surgical techniques, may diminish the risk of long-term pain among patients with atypically high preoperative pain levels.

Strengths of our study include the population-based approach and the large sample size, albeit too small for precise estimates in relation to factors such as operative technique. The prevalence of residual pain after hernia surgery estimated in this study is considered to mirror population-based results in Sweden, since hospital-based health care, in practice, is population-based and referable only to mutually exclusive hospital catchment areas. An important drawback is that we did not include patients who underwent further inguinal surgery during the 24- to 36-month follow-up period. According to the register, the proportion of the year 2000 cohort that underwent reoperation during our follow-up period was 1.5%. Some of these reoperations might have been prompted by inguinal pain with or without noticeable hernia recurrence, which could lead to an underestimation of the prevalence of severe postoperative pain. Another limitation is the lack of clinical evaluation of the patients who reported residual pain. Although the questionnaire contained questions that were designed to capture obvious recurrences, some of the patients with residual pain may still have had a recurrent hernia.

Hernia surgery has hitherto been focused on attempts to reduce the risk of recurrences, but prevention of long-term pain may require other approaches. To a certain extent, however, efforts aimed at reducing the recurrence rate are likely to coincide with those required to avoid residual pain. Consistent with this assumption is the fact that postoperative complications are a major risk factor for both recurrence[19] and for long-term pain. Although unproven in controlled trials, a meticulous technique in the dissection probably will decrease the risk of recurrence as well as of pain. When considering other aspects of surgery, such as choice of repair, the risk of long-term pain may have to be weighed against the risk of recurrence. Furthermore, careful steps to control pain among younger patients and patients with a high level of preoperative pain are important potential fields of improvement and research. One obvious step that is necessary to make improvement possible regarding the endpoint long-term

pain is to include evaluation of pain after some years in quality assurance systems for hernia surgery.

REFERENCES

1. Nilsson E, Haapaniemi S. Hernia registers and specialization. *Surg Clin North Am*. 1998;78:1141–1155.
2. Kehlet H, Bay-Nielsen M, Kingsnorth A. Chronic postherniorrhaphy pain: a call for uniform assessment. *Hernia*. 2002;6:178–181.
3. Bay-Nielsen M, Perkins FM, Kehlet H. Pain and functional impairment 1 year after inguinal herniorrhaphy: a nationwide questionnaire study. *Ann Surg*. 2001;233:1–7.
4. SBR (Swedish Hernia Register web site). May 8, 2005. Available at https://sbr.norrnod.se/html/welcome.stm.
5. Franneby U, Gunnarsson U, Wollert S, et al. Discordance between the patient's and surgeon's perception of complications following hernia surgery. *Hernia*. 2005;9:145–149.
6. Sjödén PO, Bates S, Nyrén O. Continuous self-recording of epigastric pain with two rating scales: compliance, authenticity, reliability and sensitivity. *J Behav Asess*. 1983;5:327–344.
7. Altman DG, Gardner MJ. *Statistics With Confidence*. BMJ, 2000.
8. Poobalan AS, Bruce J, King PM, et al. Chronic pain and quality of life following open inguinal hernia repair. *Br J Surg*. 2001;88:1122–1126.
9. Condon RE. Groin pain after hernia repair. *Ann Surg*. 2001;233:8.
10. Post S, Weiss B, Willer M, et al. Randomized clinical trial of lightweight composite mesh for Lichtenstein inguinal hernia repair. *Br J Surg*. 2004;91:44–48.
11. Neumayer L, Giobbie-Hurder A, Jonasson O, et al. Open mesh versus laparoscopic mesh repair of inguinal hernia. *N Engl J Med*. 2004;350:1819–1827.
12. Douek M, Smith G, Oshowo A, et al. Prospective randomised controlled trial of laparoscopic versus open inguinal hernia mesh repair: five year follow up. *BMJ*. 2003;326:1012–1013.
13. Grant AM, Scott NW, O'Dwyer PJ. Five-year follow-up of a randomized trial to assess pain and numbness after laparoscopic or open repair of groin hernia. *Br J Surg*. 2004;91:1570–1574.
14. Wright D, Paterson C, Scott N, et al. Five-year follow-up of patients undergoing laparoscopic or open groin hernia repair: a randomized controlled trial. *Ann Surg*. 2002;235:333–337.
15. Courtney CA, Duffy K, Serpell MG, et al. Outcome of patients with severe chronic pain following repair of groin hernia. *Br J Surg*. 2002;89:1310–1314.
16. Gunnarsson U. Quality assurance in surgical oncology: colorectal cancer as an example. *Eur J Surg Oncol*. 2003;29:89–94.
17. McCormack K, Go PM, Ross S, et al. Laparoscopic techniques versus open techniques for inguinal hernia repair: the Cochrane Library. Update Software (CD 1785), 2003.
18. Nordin P, Haapaniemi S, van der Linden W, et al. Choice of anesthesia and risk of reoperation for recurrence in groin hernia repair. *Ann Surg*. 2004;240:187–192.
19. Nilsson E, Haapaniemi S, Gruber G, et al. Methods of repair and risk for reoperation in Swedish hernia surgery from 1992 to 1996. *Br J Surg*. 1998;85:1686–1691.