Surgical Endoscopy (2024) 38:1170–1179
https://doi.org/10.1007/s00464-023-10606-9

Incidence and risk factors of metachronous contralateral inguinal hernia development up to 25 years after unilateral inguinal hernia repair: a single-centre retrospective cohort study

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Received: 20 July 2023 / Accepted: 17 November 2023 / Published online: 11 December 2023

Abstract

Background Patients undergoing unilateral inguinal hernia repair (IHR) are at risk of metachronous contralateral inguinal hernia (MCIH) development. We evaluated incidence and risk factors of MCIH development up to 25 years after unilateral IHR to determine possible indications for concomitant prophylactic surgery of the contralateral groin at the time of primary surgery.

Methods Patients between 18 and 70 years of age undergoing elective unilateral IHR in the University Hospital of Leuven from 1995 to 1999 were studied retrospectively using the electronic health records and prospectively via phone calls. Study aims were MCIH incidence and risk factor determination. Kaplan–Meier curves were constructed and univariable and multivariable Cox regressions were performed.

Results 758 patients were included (91% male, median age 53 years). Median follow-up time was 21.75 years. The incidence of operated MCIH after 5 years was 5.6%, after 15 years 16.1%, and after 25 years 24.7%. The incidence of both operated and non-operated MCIH after 5 years was 5.9%, after 15 years 16.7%, and after 25 years 29.0%. MCIH risk increased with older age and decreased in primary right-sided IHR and higher BMI at primary surgery.

Conclusion The overall incidence of MCIH after 25-year follow-up is 29.0%. Potential risk factors for the development of a MCIH are primary left-sided inguinal hernia repair, lower BMI, and older age. When considering prophylactic repair, we suggest a patient-specific approach taking into account these risk factors, the surgical approach and the risk factors for chronic postoperative inguinal pain.

Keywords Metachronous contralateral inguinal hernia · Prophylactic repair · Long-term follow-up · Risk factors

Inguinal hernia repair (IHR) has been the cornerstone of abdominal wall surgery for over a century [1]. The globalisation of laparoscopic approaches and using a permanent mesh instead of open repair and suture only were important milestones in its treatment, resulting in less postoperative pain and lower recurrence rates [2–4]. Consequently, the repair can now be done as an outpatient procedure. The main complications are recurrence and chronic postoperative inguinal pain (CPIP), the latter being the most important long-term complication [5–8].

A possible burden is the need to reoperate because of metachronous contralateral inguinal hernia (MCIH) development. It has been suggested to perform contralateral prophylactic surgery at the time of unilateral IHR. Prophylactic surgery is defined as reinforcement of the groin with a mesh when there is no inguinal hernia present at the time [9]. To perform prophylactic surgery a complete dissection of the groin is necessary, identical to standard inguinal hernia repair. Yet, supporting evidence is limited. Although

Matthias Van Aerde and Schila Vissers have contributed equally to the publication.

The abstract of this article was presented at the Barcelona 2023 European hernia society congress during the "BJS session". The abstract was also presented at the Belgian Surgical Week 2023 during the oral presentation session.

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the risks for postoperative complications after prophylactic surgery are considered low, there are no studies on postoperative outcome for IHR with concomitant contralateral prophylactic surgery. Particularly no statement can be made about CPIP incidence after prophylactic surgery, although bilateral laparoscopic IHR is not considered a risk factor for CPIP [10]. Therefore, it remains difficult to estimate whether or not prophylactic surgery is to be encouraged. Performing a second operation at a later age carries its own set of complications and demands a second admission. The additional risk of postoperative complications should be weighed against the risk of MCIH development without prophylactic surgery. This dilemma calls for a cohort study with a considerable long-term patient follow-up after unilateral IHR, especially as advancing age with subsequent weakening of tissues is a risk factor for the development of abdominal wall insufficiencies [11].

The aim of this study is to determine the incidence of MCIH after a follow-up up to 25 years and the risk factors for MCIH development.

Methods

In this retrospective study, all elective primary unilateral IHRs performed in the University Hospital of Leuven between 1st January 1995 and 31st December 1999 were identified in our patient database. Patients between 18 and 70 years old at the time of the index (primary) surgery were included. Exclusion criteria were isolated femoral or obturator hernias, bilateral, recurrent, and urgent IHRs. Patients with clinically or radiographically confirmed occult contralateral inguinal hernias preoperatively or previous contralateral inguinal hernia repair were equally excluded. Since the performed IHR techniques in our centre are open (Lichtenstein) and laparoscopic (totally extraperitoneal, TEP), intraoperative abdominal exploration of the contralateral groin was not systematically performed.

The primary outcome parameter was MCIH incidence. Both operated (symptomatic) and non-operated (asymptomatic) MCIHs were identified. Of note, all MCIHs that were not operated were categorised as asymptomatic, independent of whether the patient had actual symptoms or not.

Potential risk factors for developing an MCIH were analysed. These include smoking habits ($\leq$ 15 years prior to index surgery), presence of other types of abdominal wall hernia, chronic intra-abdominal pressure load prior to index surgery (i.e. heavy lifting, chronic coughing, constipation), first-generation family history of abdominal wall hernias, side of index surgery (right/left), sex, age (continuous variable), body mass index (BMI, continuous variable), type of inguinal hernia (medial/lateral/combined), and open or laparoscopic repair.

Information about these parameters at the time of index surgery was obtained by evaluation of the full individual electronic health records. For the remainder of the article, when mentioning a risk factor we refer to the values at the time of index surgery.

From 1st January 2020 until 31st December 2020, the same health records were scrutinised for occurrence of MCIH during the entire follow-up period. For the primary outcome, we distinguished between operated and non-operated MCIHs.

All patients alive at time of follow-up were contacted by telephone for actualisation of the primary outcome and to obtain missing data from the record (smoking history and family history of abdominal wall hernias). All telephone calls were performed by doctors and with a standardised questionnaire (Addendum 1). The doctors who performed the telephone calls did not participate in any kind of way in the index or MCIH operations. Patients who deceased before 1st January 2020 were included with their health record data exclusively.

The follow-up time was calculated using the last clinical contact of the patients, hence the moment of surgery or the follow-up telephone call. Deceased patients and patients lost to follow-up were censored from the date of last clinical contact.

The programme SAS 9.4 for Windows was used to perform statistical analysis. Two different Kaplan–Meier curves were constructed. An event was defined as MCIH surgery (symptomatic) in the first KM curve and MCIH with or without surgery (symptomatic and asymptomatic) in the second. Hazard ratios and 95% confidence intervals were reported from univariable and additive multivariable Cox regressions. Descriptive information on the follow-up time was obtained using the Kaplan–Meier estimate of potential follow-up [12].

Ethical approval of the Ethical Committee UZ Leuven was obtained before the start of the study. Oral informed consent was obtained from each patient alive at time of telephone contact. The study was retrospectively registered at ResearchRegistry and can be consulted with registration number 9246. The study protocol is provided as Addendum 2.

Results

Demographics and incidence of MCIH

A total of 758 patients were included: 91% were men and median age at the time of index surgery was 53 years. Index surgery was equally divided between laparoscopic (48.7%) and open surgery (51.3%). Most patients had a lateral inguinal hernia, either unique (67.5%) or in combination with a medial hernia (7.7%), with medial hernias being less frequent (24.8%) (Table 1). The prevalence of the potential risk factors is also presented in Table 1. At the end of our data collection, 506 patients were still alive; 83 of them could not be reached by telephone.

The incidence of operated MCIH after 25 years was reported at 24.7% (95% CI 21.6–28.2%) and of both operated and non-operated MCIH at 29.0% (95% CI 25.7–32.6%) (Figs. 1, 2). Median follow-up time was 21.75 years.

Table 1 Demographics and potential risk factors

Variable	Statistic	All subjects
Sex		
Female	*n*/*N* (%)	67/758 (8.84%)
Male	*n*/*N* (%)	691/758 (91.16%)
Age at index surgery	*N*	758
	Mean	51.03
	Std	13.541
	Median	53.00
	IQR	(41.00; 63.00)
	Range	(18.00; 70.00)
Smoking		
Non-smoking	*n*/*N* (%)	330/612 (53.92%)
(Ex)-smoker	*n*/*N* (%)	282/612 (46.08%)
Family history		
Negative	*n*/*N* (%)	286/399 (71.68%)
Positive	*n*/*N* (%)	113/399 (28.32%)
Chronic intra-abdominal pressure load		
Negative	*n*/*N* (%)	180/407 (44.23%)
Positive	*n*/*N* (%)	227/407 (55.77%)
BMI	*N*	359
	Mean	25.57
	Std	3.892
	Median	24.84
	IQR	(23.03; 27.68)
	Range	(17.35; 45.20)
Hernia type		
Lateral	*n*/*N* (%)	476/705 (67.52%)
Medial	*n*/*N* (%)	175/705 (24.82%)
Combined	*n*/*N* (%)	54/705 (7.66%)
Other hernias		
None	*n*/*N* (%)	686/758 (90.50%)
Primary	*n*/*N* (%)	43/758 (5.67%)
Secondary	*n*/*N* (%)	22/758 (2.90%)
Primary + secondary	*n*/*N* (%)	7/758 (0.92%)
Other hernias		
No	*n*/*N* (%)	686/758 (90.50%)
Yes	*n*/*N* (%)	72/758 (9.50%)
Side		
Left	*n*/*N* (%)	328/758 (43.27%)
Right	*n*/*N* (%)	430/758 (56.73%)
Type of surgery		
Open	*n*/*N* (%)	389/758 (51.32%)
Laparoscopy	*n*/*N* (%)	369/758 (48.68%)

In case of missing data, the number of subjects is smaller than 758 patients

Risk factors for operated MCIH

Univariable analysis of operated MCIH patients showed a predisposition to MCIH for male sex [HR 2.450 (95% CI 1.146; 5.238)], older age at index surgery [per 1 year HR 1.015 (95% CI 1.002; 1.029)], and open index surgery [HR 1.514 (95% CI 1.079; 2.125)]. A decreased risk for MCIH was seen in primary right-sided IHR [HR 0.619 (95% CI 0.446; 0.860)] and in patients with a higher BMI at index surgery [per point BMI: HR 0.927 (95% CI 0.867; 0.990, Table 2].

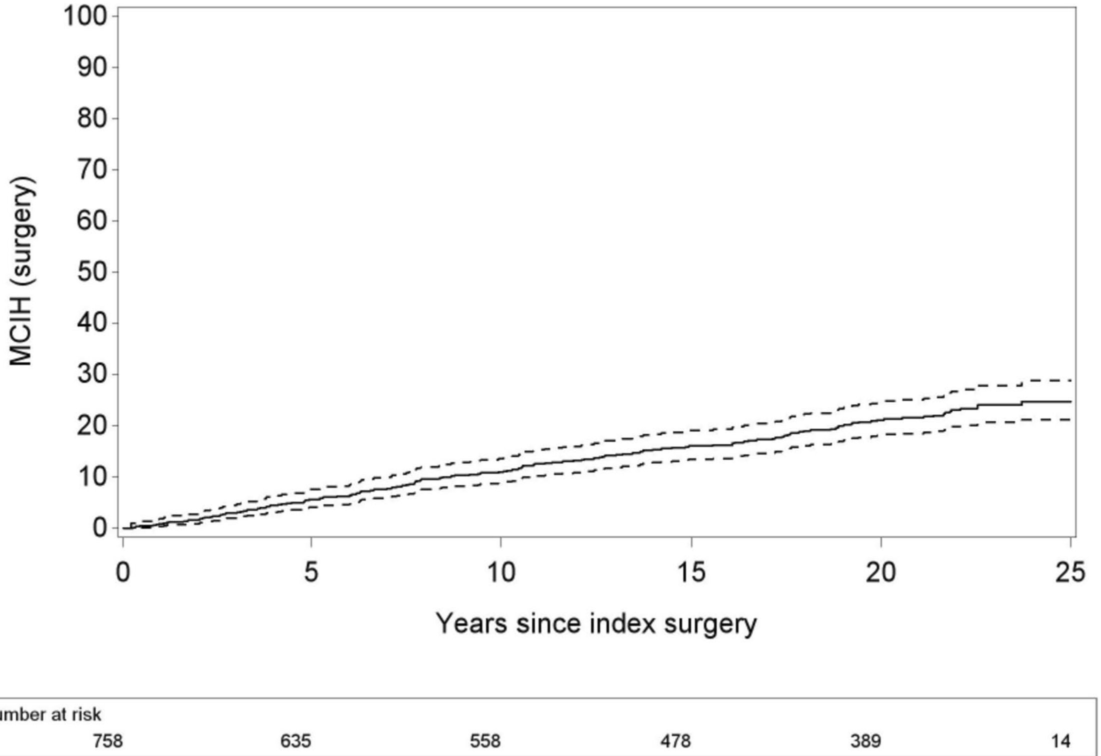
In the multivariable analysis, the variables smoking, family history, type of hernia, and chronic intra-abdominal pressure load prior to index surgery were not considered due to missing data. For BMI, more than half of the subjects had a missing value. Since BMI was significant in the univariable setting, its effect was verified in a separate multivariable model.

The multivariable analysis without BMI confirmed the predisposition of MCIH for male sex [HR 2.320 (95% CI 1.078; 4.991)] and older age at index surgery [HR per year 1.016 (95% CI 1.003; 1.030)]. The HR for age increases per year: a patient who was ten years older at the time of index surgery has a 17.2% higher chance of developing a MCIH (1.016 HR ^ 10 years = 1.172). Lower incidence of MCIH following primary right-sided IHR was confirmed as well [HR 0.614 (95% CI 0.442; 0.854)]. In contrast, the significant predisposition of open index surgery for MCIH was not confirmed in the multivariable analysis (Table 3).

The multivariable analysis with BMI showed a lower risk for MCIH with increasing BMI at index surgery [HR per point increase in BMI 0.900 (95% CI 0.836; 0.970)] and primary right-sided IHR [HR 0.534 (95% CI 0.335; 0.850)]. Older age at index surgery was associated with an increased risk of MCIH [HR 1.031 (95% CI 1.011; 1.051)]. The effect of male sex became non-significant when adding BMI [HR 1.871 (95% CI 0.679; 5.160), Table 4].

Risk factors for operated and non-operated MCIH

Univariable analysis of all MCIH patients (operated and non-operated) showed a predisposition to MCIH for older age at index surgery [per 1-year HR 1.016 (95% CI 1.003; 1.028)] and open index surgery [HR 1.432 (95% CI 1.046; 1.961)]. A decreased risk for MCIH was seen in primary right-sided IHR [HR 0.688 (95% CI 0.507; 0.934)] and



Years since index surgery	MCIH (surgery)	95% confidence interval	
		Lower Limit	Upper Limit
1	0.83	0.38	1.84
3	3.10	2.07	4.65
5	5.59	4.15	7.51
10	10.95	8.92	13.40
15	16.07	13.66	18.86
20	21.16	18.44	24.22
25	24.72	21.64	28.16

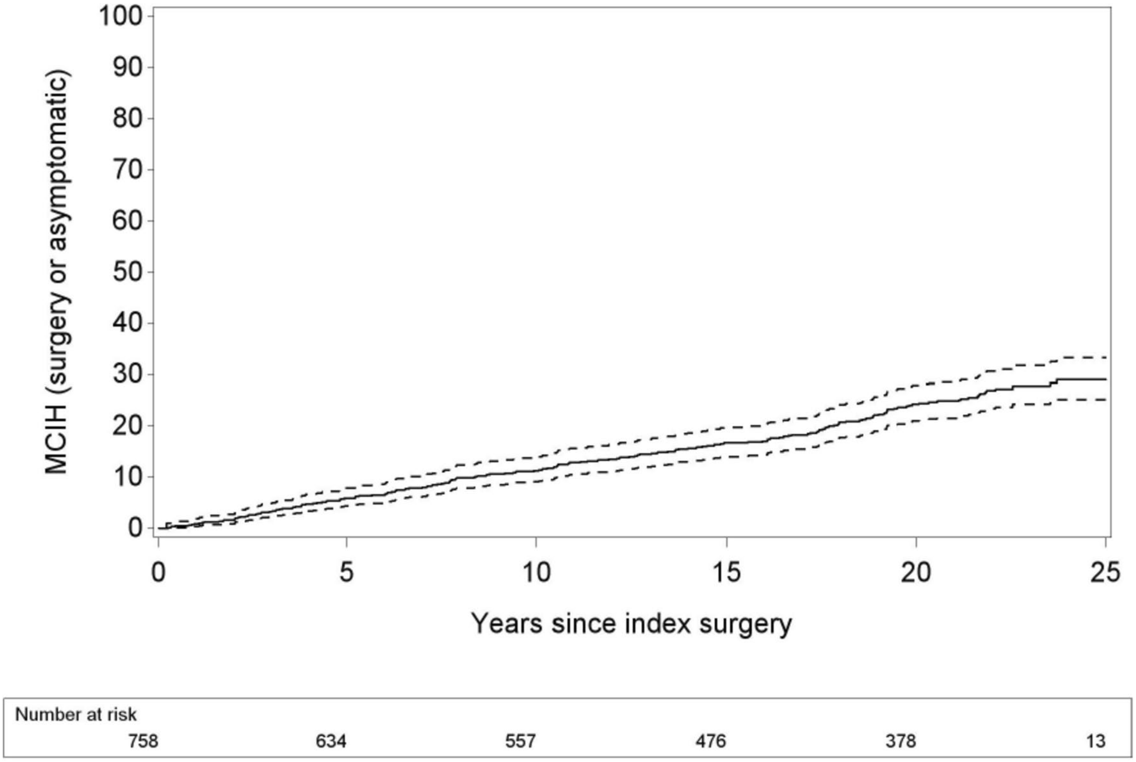
Fig. 1 Kaplan–Meier curve operated MCIH. Kaplan–Meier curve with registration of operated MCIHs. The number at risk signifies the number of patients without MCIH and with follow-up information. The dashed lines refer to the 95% confidence interval for the Kaplan–Meier estimates

in patients with a higher BMI at index surgery [HR 0.930 (95% CI 0.874; 0.989), Table 2].

Similar to the multivariable analysis of operated MCIH patients, separate multivariable models with and without BMI were constructed for analysis of all MCIH patients. Also because of missing data, smoking, family history, type of hernia, and chronic intra-abdominal pressure load prior to index surgery were not considered in this model.

The multivariable analysis without BMI showed a predisposition for MCIH for patients with an older age at index surgery [HR 1.016 (95% CI 1.004; 1.029)] and a lower risk of MCIH for patients with primary right-sided IHR [HR 0.681 (95% CI 0.501; 0.926), Table 3].

In the multivariable analysis with BMI, the results for older age at index surgery [HR 1.026 (95% CI 1.008; 1.045)] and primary right-sided IHR [HR 0.583 (95% CI 0.377; 0.901)] were confirmed. It also showed a protective effect of higher BMI at index surgery against MCIH [HR 0.907 (95% CI 0.847; 0.972), Table 4].



Years since index surgery	MCIH (surgery or asymptomatic)	95% confidence interval	
		Lower Limit	Upper Limit
1	0.83	0.38	1.84
3	3.39	2.30	4.98
5	5.87	4.40	7.82
10	11.22	9.18	13.69
15	16.68	14.23	19.49
20	24.20	21.36	27.34
25	29.00	25.73	32.58

Fig. 2 Kaplan–Meier curve operated and non-operated MCIH. Kaplan–Meier curve with registration of both operated and non-operated MCIHs. The number at risk signifies the amount of patients without MCIH and with follow-up information. The dashed lines refer to the 95% confidence interval for the Kaplan–Meier estimates

Discussion

Incidence

Our research showed an incidence for operated MCIH of 24.7% after 25 years and 29.0% for operated and non-operated MCIHs. The incidence of MCIH detection and repair is quite similar, meaning that once identified, they are most often symptomatic. Yearly incidence was constant during entire follow-up. In the current literature, there are only three articles that mention a follow-up time of at least 10 years with MCIH incidence reported at 22.8% (median follow-up time 10 years) [4], 22.6% (median follow-up time 13 years) [13], and 10.72% (median follow-up time 10 years) [14]. Brandt-Kerkhof et al.'s study was the only study that made the distinction between operated and non-operated MCIHs [13]. Zheng et al. with the largest sample size of 32,834 patients showed the lowest incidence of MCIH, reported at 10.72% [14]. The "true" MCIH incidence is likely lower than our data since occult

Table 2 Univariable analysis

	Univariable analysis (operated MCIH)			Univariable analysis (operated and non-operated MCIH)		
	N obs	*N* events	Hazard ratio (95% CI)	*N* obs	*N* events	Hazard ratio (95% CI)
Sex	758	144		758	165	
Male			2.450 (1.146; 5.238)			1.796 (0.974; 3.313)
Female			#			#
Higher age at index surgery (risk per year of age)	758	144	1.015 (1.002; 1.029)	758	165	1.016 (1.003; 1.028)
Smoking	612	132		612	150	
(Ex)-smoker			1.101 (0.782; 1.551)			1.097 (0.795; 1.513)
Non-smoking			#			
Familial history	399	88		399	99	
Familial history			1.159 (0.737; 1.824)			1.192 (0.780; 1.823)
No familial history			#			#
Chronic intra-abdominal pressure load	407	93		407	104	
Positive			1.311 (0.864; 1.990)			1.174 (0.795; 1.735)
Negative			#			#
Increasing BMI (risk per point BMI)	359	74	0.927 (0.867; 0.990)	359	84	0.930 (0.874; 0.989)
Hernia type	705	132		705	150	
Medial			0.805 (0.525; 1.232)			0.984 (0.671; 1.443)
Combined			0.784 (0.381; 1.611)			0.912 (0.476; 1.744)
Lateral			#			#
Other hernias	758	144		758	165	
Primary			1.644 (0.946; 2.856)			1.635 (0.975; 2.740)
Primary + secondary			0.813 (0.114; 5.817)			0.709 (0.099; 5.067)
Secondary			0.799 (0.254; 2.511)			0.699 (0.223; 2.192)
None			#			#
Other hernias	758	144		758	165	
Any other			1.334 (0.814; 2.186)			1.291 (0.809; 2.061)
No other hernia			#			#
Side	758	144		758	165	
Right			0.619 (0.446; 0.860)			0.688 (0.507; 0.934)
Left			#			#
Type of surgery	758	144		758	165	
Open			1.514 (1.079; 2.125)			1.432 (1.046; 1.961)
Laparoscopy			#			#

Potential risk factors with results of the univariable analysis. "#" is the reference value. Hazard ratios are shown with a 95% confidence interval. "N obs" is the total number of observants. "N events" is the number of registered MCIH's

asymptomatic contralateral hernias present at time of surgery could have been missed.

Possible risk factors for MCIH

MCIH development after primary right-sided IHR was significantly less common [HR 0.614 (95% CI 0.442; 0.854)]. This confirms previously reported findings in a paediatric study population [15, 16]. Furthermore, it is known that inguinal hernias are more commonly right-sided [17]. There is an ongoing debate regarding the aetiology for this finding [18, 19].

Our analysis showed a decreased risk for MCIH per unit increasing BMI (kg/m^2) at the time of index surgery. Because of the large number of missing data, these results should be interpreted cautiously. BMI was only measured at the time of index surgery, so there are no records of the evolution of BMI during follow-up. Of note, the median BMI of the patient population was 24.8 kg/m^2.

A similar protective effect of higher BMI against MCIH development was reported before by Zheng et al. in 2016; they reported an OR of 0.3 (CI 95% 0.1–0.8) for development of MCIH in obese patients (BMI > 30 kg/m^2) [14]. However, another retrospective study by Zendejas et al.

Table 3 Multivariable analysis without BMI as a variable

	Multivariable analysis (operated MCIH)	Multivariable analysis (operated and non-operated MCIH)
	Hazard ratio (95% CI)	Hazard ratio (95% CI)
Sex		
Male	2.320 (1.078; 4.991)	1.709 (0.921; 3.172)
Female	#	#
Higher age at index surgery	1.016 (1.003; 1.030)	1.016 (1.004; 1.029)
Other hernias		
Primary and/or secondary	1.374 (0.836; 2.257)	1.309 (0.818; 2.095)
No other hernia	#	#
Side		
Right	0.614 (0.442; 0.854)	0.681 (0.501; 0.926)
Left	#	#
Type of surgery		
Open	1.401 (0.995; 1.972)	1.348 (0.981; 1.852)
Laparoscopy	#	#

Potential risk factors with results of the multivariable analysis without including BMI as a variable. "#" is the reference. Hazard ratios are shown with a 95% confidence interval

Table 4 Multivariable analysis with BMI as a variable

	Multivariable analysis (operated MCIH)	Multivariable analysis (operated and non-operated MCIH)
	Hazard ratio (95% CI)	Hazard ratio (95% CI)
Sex		
Male	1.871 (0.679; 5.16)	1.422 (0.615; 3.284)
Female	#	#
Higher age at index surgery	1.031 (1.011; 1.051)	1.026 (1.008; 1.045)
Increasing BMI	0.900 (0.836; 0.970)	0.907 (0.847; 0.972)
Other hernias		
Primary and/or secondary	1.655 (0.820; 3.339)	1.618 (0.832; 3.147)
No other hernia	#	#
Side		
Right	0.534 (0.335; 0.850)	0.583 (0.377; 0.901)
Left	#	#
Type of surgery		
Open	1.153 (0.708; 1.879)	1.135 (0.719; 1.792)
Laparoscopy	#	#

Results of the multivariable analysis with BMI included as a variable. "#" is the reference. Hazard ratios are shown with a 95% confidence interval

could not confirm this effect [8]. Either way, increasing BMI is a known protective factor against the development of an inguinal hernia in general [2, 20]. The precise pathophysiology behind the protective effect of high BMI on inguinal hernia development remains unclear [21]. One hypothesis is that excessive fat tissue in the preperitoneal groin region might strengthen the abdominal wall musculature, providing a better protection against hernia development [20]. However, underdiagnosis due to difficulty in investigating heavier patients might be a confounder effect.

Increased age at index surgery (per year) showed an increased risk for MCIH development. This confirms previous results mentioned in three retrospective studies [14, 22, 23]. In older patients, prophylactic surgery could avoid an operation at an even older age when the general condition of the patient has possibly worsened with increased perioperative concerns. However, the risk of developing a symptomatic hernia decreases with decreased life expectancy and one could wonder whether prophylactic surgery would still be useful after a certain age.

Male sex showed an increased risk for developing a symptomatic MCIH in the multivariable analysis for symptomatic patients. Zheng et al. also showed the same predisposition [14]. These results correspond with the known increased risk for inguinal hernia for male patients in general [2]. However, when only analysing patients with known BMI in our study, this effect became non-significant nor was it confirmed when adding asymptomatic MCIH patients.

Open surgery showed an increased risk for MCIH development in our univariable analysis. This effect was not confirmed in our multivariable analysis. There is no evidence in the available literature to this date that suggests this association.

When considering the symptomatic patient group separately, we only found a difference in male sex when compared to the symptomatic and asymptomatic patient group. It is unclear what caused this difference.

Several other patient parameters have been conventionally regarded as risk factors. Family history of inguinal hernia or presence of other types of hernia assumes some kind of genetic predisposition for hernia development in general [2]. Smoking and coughing, heavy lifting, and other types of chronic intra-abdominal pressure load are presumed to accelerate deterioration of abdominal wall integrity [24]. The clinical relevance of these risk factors was not confirmed in our study, possibly in part due to the amount of missing data.

Prophylactic mesh augmentation of a healthy groin

As mentioned before, prophylactic inguinal surgery is defined as the reinforcement of the groin with a mesh when there is no inguinal hernia present. There is ongoing debate regarding concomitant contralateral prophylactic surgery during unilateral inguinal hernia repair. It could result in a socioeconomic advantage, since only one (outpatient) clinic admission and one period of sick leave are necessary, thereby improving the patient's personal experience. However, CPIP and other complications can occur not only on the symptomatic side but also on the "healthy" contralateral side. There are currently no studies reporting on the outcome of prophylactic surgery of a healthy unaffected groin. However, there is extensive research on bilateral IHR, where an asymptomatic contralateral hernia is detected and fixed at the same time as the symptomatic inguinal hernia.

There is sufficient evidence to conclude that bilateral laparoscopic IHR is not a risk factor for CPIP [2, 10]. However, it has been shown that in low-volume centres short-term postoperative complications requiring reoperation are significantly higher for bilateral TEP-IHR (1.78% vs. 0.82%) and transabdominal preperitoneal (TAPP)-IHR (1.96% vs. 0.90%) [25, 26], the complication rate evened out in a high-volume centre case series [27]. Therefore, it has been recommended that prophylactic surgery is best performed by experienced endoscopic surgeons [25, 26]. However, it is important to acknowledge that bilateral inguinal hernia repair is a completely different clinical situation than prophylactic surgery and research on prophylactic surgery has to be conducted.

When performing inguinal hernia repair and considering prophylactic mesh augmentation of the healthy contralateral groin, it is important to see if the risk factors mentioned above correspond with risk factors for CPIP. A systematic review showed strong evidence for increased risk for CPIP in female patients, younger patients, open IHR, high intensity pain perioperatively, history of chronic pain other than CPIP and repair of a recurrent inguinal hernia [10]. It is interesting to see that older age and male sex are risk factors for MCIH and at the same time protective factors against CPIP. A suggested approach therefore could be to perform prophylactic surgery in patients with a high risk of MCIH and low risk of CPIP. Laparoscopy is the preferred technique, because laparoscopic repair of a virgin groin will add only minimal extra surgical time and morbidity, whilst an open repair has an increased risk for CPIP.

We believe that our results are not in favour of a systematic prophylactic contralateral IHR at time of index surgery for unilateral inguinal hernias. Furthermore, the incidence of CPIP affecting normal daily activities ranges from 0.5 to 6% [2], which is a debatably high complication rate for prophylactic surgery. However, our results do show potential risk factors for MCIH development. Based on this, an older leaner (male) patient with a left-sided inguinal hernia could be a good candidate for (laparoscopic) prophylactic repair.

Strengths and weaknesses of the study

The biggest strength of our study is the long follow-up time together with the prospective phone survey of the living patients. To our knowledge, this is the longest follow-up time in the current literature.

The weaknesses of our study are the retrospective design, single-centre study, amount of missing data for some risk factors, and the fact that some patients were deceased or could not be reached by telephone. The latter two could cause an underestimation of the MCIH incidence. On the other hand, overestimation of MCIHs is possible because all laparoscopic IHRs were TEP, in which intraoperative contralateral groin exploration was not systematically performed and thus occult asymptomatic contralateral hernias present at time of surgery could have been missed. Data about smoking and familial history were retrieved from the medical files for all patients, and missing data were obtained only for patients reachable by phone. As a consequence, there is a difference in data collection for smoking and family history of abdominal wall hernia, between reachable patient and non-reachable patients (living or deceased). Furthermore, smoking was registered with an arbitrary cut-off of 15 years; this differs from the standard used pack years. Presence of potential risk factors was only verified for the time of index surgery. Therefore, we have no data on the evolution of these risk factors during follow-up.

Conclusion

We report an overall MCIH incidence of 29% over a maximum of 25-year follow-up. Our results show that potential risk factors for the development of a MCIH are primary left-sided inguinal hernia repair, lower BMI, (male sex), and older age. When considering prophylactic mesh augmentation of a healthy contralateral groin at time of index surgery, we suggest a patient-specific approach taking these risk factors, the surgical approach, and the generally known risk factors for CPIP into account.

Future prospects

Prospective studies are needed to confirm and determine additional risk factors for MCIH and help physicians understand the underlying pathophysiology. This can help us to make evidence-based decisions whether prophylactic contralateral IHR is warranted. Moreover, patient-reported outcome measures of prophylactic surgery need to be studied in detail.

Supplementary Information The online version contains supplementary material available at https://doi.org/10.1007/s00464-023-10606-9.

Acknowledgements We wish to thank Xavier De Raeymaeker for his contribution to the data collection.

Funding This study was not funded by any private or public organisation.

Data availability All data and statistical analysis can be requested through email with the corresponding author.

Declarations

Disclosures Marc Miserez has a research grant at FEG Textiltechnik, at Medtronic, and at BD. He also has a consulting fee through Tissium SA with payment to the institution and he is Member of the European Commission Expert Panel in the field of Medical Devices for "General and plastic surgery and dentistry" & Vice-Chair Subgroup "Surgical Implants and general surgery". Robin Glorieux, Matthias Van Aerde, Schila Vissers, Steffen Fieuws, and Pieter De Groof have no conflicts of interest or financial ties to disclose.

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