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ORIGINAL ARTICLE

Outpatient groin hernia repair: assessment of 9330 patients from the French "Club Hernie" database

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Abstract

Background Groin hernia repair (GHR) is one of the most frequent surgical interventions practiced worldwide. Outpatient surgery for GHR is known to be safe and effective.

Aim To assess the outpatient practice for GHR in France and identify predictive factors of failure.

Method Forty one surgeons of the French "Club Hernie" prospectively gathered data concerning successive GHR over a period of 4 years within a multicenter database.

Results A total of 9330 patients were operated on during the period of the study. Mean age was 61.8 (1–100) years old and 8245 patients (88.4%) were males. 6974 GHR (74.7%) were performed as outpatient procedures. In 262 patients (3.6%), the outpatient setting, previously selected, did not succeed. Upon multivariate analysis, predictive factors of ambulatory failure were ASA grade ≥ III (OR 0.42, $p < 0.001$), bilateral GHR (OR 0.47, $p < 0.001$), emergency surgery for incarcerated hernia (OR 0.10, $p < 0.001$), spinal anesthesia (OR 0.27, $p < 0.001$) and occurrence of an early post-operative complication (OR 0.07, $p < 0.001$). The more frequent complications were acute urinary retention and surgical site collections. 2094 patients (21.5%) were not selected preoperatively for 1-day surgery.

Conclusion More than 74% of the patients benefited from outpatient surgery for GHR with a poor failure rate. Predictive factors of outpatient GHR failure were ASA grade ≥ III, bilateral GHR, emergency surgery for incarcerated hernia, spinal anesthesia and occurrence of an early post-operative complication. Ambulatory failures were often related to social issues or medical complications. Outpatient surgery criteria could become less restrictive in the future.

Keywords Groin hernia repair · Outpatient · Ambulatory · Laparoscopic groin hernia repair

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Introduction

Groin hernia repair (GHR) is a very frequent surgical intervention practiced in daily routine. About 140,000 are performed every year in France according to the "Programme de Médicalisation des Systèmes d'Information" data [1]. Ambulatory procedures/outpatient procedures/1-day surgery are defined, in France, as a hospital stay < 12 h. Outpatient surgery for GHR is considered to be a safe, feasible and cost-effective practice [2]. Although outpatient surgery for GHR has become a common procedure, some factors still slow down its progression. The aim of this study was to assess the outpatient practice for GHR in France and to identify factors of preoperative selection and failure.

Method

Data collection

A large scale database concerning GHR practice in France was established at the initiative of the "Club Hernie". "Club Hernie" is a group of experienced surgeons, spread across France and particularly familiar with groin hernia surgery. Within this group, surgeons must prospectively collect their data regarding every abdominal wall procedure in a dedicated registry.

Forty one visceral surgeons prospectively gathered the data of successive inguinal hernias between 01/09/2011 and 31/08/2015. Every patient signed an informed consent prior to inclusion in the database. Data concerning patient characteristics were completed preoperatively. ASA grade was determined by the anesthesiologist. Surgical technic employed was left to the discretion of the surgeon. Peroperative data were filled out online in real time after each procedure. Post-operative items were completed along the way of the follow-up. The patients were seen by their surgeon before discharge. Then, each patient was seen by the surgeon 1 month after the surgery or before if necessary. Post-operative results were blindly analyzed by an independent clinical research associate. If a mismatch was noticed between the patient's statement and the database, the medical records were consulted.

Data collected in the database were

- Patient characteristics (age, sex, body mass index, occupation, sport practice, history of hernia, ASA grade).
- Hernia characteristics (preoperative symptoms, site, unilateral or bilateral, primary or recurrence).
- Procedure (surgical technic employed, operating time, outpatient or inpatient setting, length of stay, complication, type of anesthesia).
- Causes if ambulatory was not proposed or failed.

Outpatient procedure was defined as a hospital stay < 12 h, with admission and discharge on the same day, in accordance with the French definition [3]. The outpatient setting was decided by both the surgeon and the anesthesiologist. The reasons why the patient had not been selected for an outpatient procedure were reported in the database as well as the causes of failure of a previously selected outpatient setting. Complications were divided into medical complications, surgical site collections (SSC) and surgical complications. Early post-operative complications were medical (acute urinary retention, cardiovascular or neurological disorders) or surgical complications likely to delay the discharge of the patient. Infected and uninfected collections (seroma, hematoma) were considered as surgical site collections.

Statistical analysis

Comparison of qualitative and quantitative data was, respectively, performed using the Chi-squared test and the Student's *t* test. Multivariate logistic regression models were used to identify predictive factors of (i) whether or not an ambulatory procedure was proposed (yes/no) and (ii) whether a proposed ambulatory procedure was successful or not (yes/no). These analyses were adjusted for center. Potential collinearity of factors in the multivariate analysis was assessed based on clinical reasoning and the variation of regression coefficients upon removal of a factor in the model. Statistical analyses were performed using the R version 3.2.3 software program (R: A language and environment for statistical computing. R foundation for Statistical Computing, Vienna, Austria). p values < 0.05 were considered significant. For the multivariate analyses, p values were adjusted using the step-down Dunnett test implemented in the R package multcomp and described in Bretz et al., Section 4.1.2 [4, 5]. All results are based on a complete case analysis.

Results

A total of 9330 patients were operated on between 01/09/2011 and 31/08/2015 (Table 1). The mean age was 61.8 (1–100) years. The population was mainly made up of male patients (88.4%). 1348 patients (14.4%) had an ASA grade ≥ III. 653 (7%) operated hernias were recurrences. 116 (1.2%) patients were operated on for an incarcerated hernia in emergency.

6974 (74.7%) procedures were performed as an outpatient surgery (Table 2). Respectively, 4237 (45.4%) and 5093 (54.6%) patients underwent laparoscopic and open procedures. Most of the procedures were performed under

Table 1 Patients characteristics

	Mean ± SD (range), or *n* (%)	*N* missing (%)
Age (years)	61.8 ± 16.5 (1–100)	27 (0.3)
Sex		0 (0)
Male	8245 (88.4)	
Female	1085 (11.6)	
Body mass index (kg/m^2)	25 ± 6.2 (12–78)	91(1)
ASA grade ≥ III	1348 (14.4)	68 (0.7)
Physical occupation	3007 (32.2)	104 (1.1)
Intensive sport practice	1701 (18.2)	160 (1.7)
History of hernia	1894 (20.3)	83 (0.9)
Recurrent groin hernia	653 (7)	97 (1)
Bilateral groin hernia repair	1974 (21.2)	62 (0.7)
Preoperative symptoms		96 (1)
Asymptomatic	1430 (15.5)	
Discomfort, pain	7429 (80.5)	
Taxis and delayed intervention	259 (2.8)	
Incarcerated hernia	116 (1.2)	
Hernia site		247 (2.6)
Indirect inguinal hernia	4712 (51.9)	
Direct inguinal hernia	2112 (23.3)	
Femoral hernia	352 (3.8)	
Combined hernia	1907 (21)	

Age and BMI are summarized by their mean, standard deviation and range. Categorical variables are summarized by the number of patients in each category and the corresponding percentages

general anesthesia, but 351 (3.8%) patients were operated under spinal anesthesia.

680 (7.3%) patients suffered from a complication (Table 3). Acute urinary retention was the most frequent medical complication, occurring in 64 (0.7%) patients. 427 (4.5%) patients experienced a post-operative surgical site collection, more commonly noticed among inpatients, and widely dominated by uninfected superficial subcutaneous collections (seroma and hematoma). Bladder injury was found to be the principle surgical complication, occurring in less than 0.1% of the patients. 4 patients underwent a vascular injury (epigastric vessel injuries). Every patient victim of this latter complication was kept in the hospital for further surveillance. Medical complications occurred more frequently after open hernia repair than after laparoscopic repair (2.8 vs 0.7%, respectively, $p < 0.01$) but the rate of surgical complications was not significantly different between both procedures (0.8 vs 0.7%, respectively, $p = 0.49$). 48 (0.5%) patients underwent a complication ≥ grade IIIA of the Clavien–Dindo classification [6]. More severe complications occurred after open GHR than after laparoscopic approach (0.7 vs 0.26%, $p < 0.01$). Surgical complications were more frequent in the case of a wider hernia.

A total of 1974 (21.2%) patients were operated on for bilateral groin hernia repair (Table 4). Among these patients, 1373 (69.6%) benefited from outpatient surgery and 1179 (59.7%) were operated on with a laparoscopic technic. Patients with bilateral hernia were more likely to be treated as inpatients (30.4% vs 23.9%, $p < 0.001$) and with laparoscopic approach (59.7% vs 41.6%, $p < 0.001$) in comparison with unilateral hernia repair. Mean operative time was longer in patients treated for bilateral hernia. Complication rates did not differ between the two groups.

Patients operated on for groin hernia were mainly aged 60–80 years old (46.6%). The rate of outpatient inguinal hernia repair seems to decrease with age (97% in patients younger than 20 and 44% in patients older than 80). Laparoscopy was less used among young and old patients. Mean length of stay tends to increase with age (Table 5).

Male patients were more likely to undergo an outpatient procedure (75.9 and 66%, respectively, $p < 0.001$) and a laparoscopic GHR (46 and 41.1%, $p < 0.001$). Females experienced more femoral hernias (17%) and were more frequently operated on in emergency for a strangulated hernia (3.5%). The rate of complications was not significantly different based on gender (Table 6).

The center was also included in the analysis as an independent variable but did not greatly impact the results concerning ambulatory failure or selection for ambulatory.

Table 2 Procedures characteristics

	Mean ± SD (range), or *n* (%)	*N* missing (%)
Outpatient procedure (*n*, %)	6974 (74.7)	0 (0)
Surgical technique (*n*, %)		0 (0)
Laparoscopic hernia repair	4237 (45.4)	
TAPP	2347 (25.2)	
TEP	1880 (20.1)	
Other/NS	10 (0.1)	
Open hernia repair	5093 (54.6)	
Suture repair	326 (3.5)	
Lichtenstein	1978 (21.2)	
Plug	59 (0.6)	
Patch-plug	183 (2)	
PHS/UHS	185 (2)	
Posterior prosthetic repair	2063 (22.1)	
Other/NS	299 (3.2)	
Type of anesthesia (*n*, %)		91 (1)
General anesthesia	8606 (92.2)	
Spinal anesthesia	351 (3.8)	
Local anesthesia	69 (0.7)	
Other	213 (2.3)	
Mean operation time (min)	27.6 ± 14 (5–180)	138 (1.5)
Complications (*n*, %)	680 (7.3)	883 (9.5)
Medical	176 (1.9)	
Surgical site collections	427 (4.5)	
Surgical	77 (0.8)	
Mean length of stay (days)	0.5	

Mean operation time is summarized by mean, standard deviation and range. Categorical variables are summarized by the number of patients in each category and the corresponding percentages

TAPP TransAbdominal PrePeritoneal. *TEP* Totally ExtraPeritoneal. *NS* not specified, *PHS* Prolene® Hernia System. *UHS* Ultrapro® Hernia System

Table 3 Complications

Complications	
Medical (*n*, %)	
Acute urinary retention	64 (0.7)
Flebitis/lymphangitis	29 (0.3)
Broncho-pulmonary	12 (0.1)
Surgical site collections (*n*,%)	
Uninfected superficial sc col.	343 (3.7)
Uninfected pp col.	41 (0.4)
Infected subcutaneous col.	24 (0.3)
Surgical (*n*, %)	
Bladder injury	7 (0.07)
Vascular injury	4 (0.04)
Ischemic orchitis	17 (0.2)

Only the most common complications are reported. Complications were distinguished by medical complications, surgical site collections or surgical complications. *SC* Sub Cutaneous. *Col* Collection. *PP* Preperitoneal. Among vascular injuries, only epigastric vessel injuries occurred

Ambulatory failures

A total of 2356 (25.3%) patients did not benefit from an ambulatory procedure. Among the patients initially selected for an outpatient procedure, 262 (3.6%) failed (Table 7). ASA grade ≥ III (OR 0.42, $p < 0.001$), bilateral hernia repair (OR 0.47, $p < 0.001$), emergency surgery for incarcerated hernia (OR 0.10, $p < 0.001$), spinal anesthesia (OR 0.27, $p < 0.001$) and the occurrence of an early post-operative complication (OR 0.07, $p < 0.001$) were identified as predictive factors of ambulatory failure. Two factors, operating time and the Clavien & Dindo classification were removed from the analysis due to collinearity.

In the database, ambulatory failure causes were dominated by medical problems such as pain or fainting/headache in, respectively, 41 (15.7%) and 54 (20.6%) patients (Table 8). Acute urinary retention caused 26 (9.9%) failures. Supporting problems and late check-out from the operating room were other causes of failure.

Table 4 Bilateral hernia repair

	Bilateral hernia repair	Unilateral hernia repair	*p*
Outpatient procedure (*n*, %)	1373 (69.6)	5601 (76.1)	< 0.001
Laparoscopic GHR (*n*, %)	1179 (59.7)	3058 (41.6)	< 0.001
Mean operative time (min)	54.3	28.3	< 0.001
Complications (*n*, %)			
Medical	40 (2)	136 (1.8)	0.6
SSC	91 (4.6)	336 (4.6)	0.9
Surgical	19 (1)	58 (0.8)	0.4

SSC surgical site collections

Table 5 Results by age

Age (years)	0–20	20–40	40–60	60–80	> 80
Total no. of patients (*n*, %)	138 (1.5)	876 (9.4)	2863 (30.8)	4334 (46.6)	1092 (11.7)
Outpatient procedure (*n*, %)	135 (97.8)	754 (86)	2411 (84.2)	3173 (73.2)	485 (44.4)
Laparoscopic GHR (*n*, %)	7 (5)	431 (49.2)	1436 (50.1)	2005 (46.2)	345 (31.6)
Mean length of stay (days)	0.02	0.19	0.29	0.5	1.4

Table 6 Results by gender

	Male	Female	*p*
Total no. (*n*, %)	8245 (88.4)	1085 (11.6)	–
Outpatient procedure (n, %)	6258 (75.9)	716 (66)	< 0.001
Laparoscopic GHR (n, %)	3791 (46)	446 (41.1)	0.002
Hernia site			< 0.001
Indirect inguinal hernia	4137 (50.2)	575 (53)	
Direct inguinal hernia	1989 (24.1)	123 (11.3)	
Femoral	46 (0.6)	185 (17)	
Emergency GHR (*n*, %)	78 (0.9)	38 (3.5)	<0.001
Complications			
Medical	155 (1.9)	21 (2)	0.89
Surgical site collections	366 (4.4)	61 (5.6)	0.07
Surgical	70 (0.8)	7 (0.6)	0.48

Patients not selected for ambulatory

A total of 2094 (22.4%) patients were not selected preoperatively for an outpatient procedure (Table 9). Age (OR 0.96, $p < 0.001$), female gender (OR male vs female 1.81, $p < 0.001$), ASA grade ≥ III (OR 0.16, $p < 0.001$), recurrence of hernia (OR 0.62, $p < 0.001$), bilateral hernia (OR 0.47, $p < 0.001$), emergency surgery for incarcerated hernia (OR 0.09, $p < 0.001$), open hernia repair (OR 0.53, $p < 0.001$) and spinal anesthesia (OR 0.58, $p < 0.001$) were identified as factors influencing practitioners for not selecting patients for an ambulatory care.

In the database, the main reasons for not proposing an ambulatory procedure were mainly organizational issues, such as supporting problems in 455 (21.7%) patients, or medical considerations, particularly ASA grade ≥ III in 584 (27.9%) patients (Table 10).

Discussion

There is a relative scarcity of literature concerning 1-day surgery for GHR. Our series reported the results of nearly 10,000 GHR. We aimed to assess the current ambulatory rates of GHR in France and identify predictive factors of failure and non-selection for ambulatory. Data concerning consecutive and unselected GHR were prospectively gathered by 41 surgeons working all around the country. All comparisons were based on a complete case analysis. Since the percentages of missing data were very low for all variables, results are unlikely to be significantly impacted by missing data.

The definition of the ambulatory setting varies depending on the countries. According to the "Haute Autorité de Santé" (HAS), we considered the outpatient surgery as a hospital stay < 12 h, with admission and discharge on the same day [3]. In France, at the time of the study, the healthcare system's pricing distinguished "ambulatory" (no night spent in the hospital) and "short stay" (two nights in the hospital). If the patients spent only one night in the structure, the hospital was prejudiced. The patients were admitted in the hospital in the morning, operated on, monitored and then discharged if they satisfied the conditions of an ambulatory procedure (no pain, oral intake, deambulation, urination). If not, they were admitted in the surgical department for further surveillance and counted as failure of the outpatient setting. Postoperative pain was assessed by means of a visual analogue pain scale.

Table 7 Comparison of outpatient procedures achieved and ambulatory failures upon multivariate analysis

	Outpatient procedure	Ambulatory failure	OR	95% CI	*p*
Total no. of patients (*n*, %)	6974	262	–	–	–
Age (years)	59.2	60	1	[0.99; 1.01]	0.91
Gender (*n*, %)*					
Male	6258 (89.7)	218 (83.2)	1.59	[1.04; 2.41]	0.322
BMI (kg/m^2)	25	24.9	1.01	[0.98; 1.05]	0.53
ASA grade ≥ III (*n*, %)*	412 (5.9)	34 (13)	0.42	[0.28; 0.65]	<0.001
Physical occupation (*n*, %)	2511 (36)	92 (35.1)	0.97	[0.71; 1.32]	0.83
Intensive sport practice (*n*, %)	1497 (21.5)	40 (15.3)	1.17	[0.81; 1.70]	0.39
History of hernia (*n*, %)	1331 (19.1)	52 (19.8)	0.96	[0.65; 1.42]	0.82
Recurrence of hernia (*n*, %)	427 (6.1)	18 (6.8)	0.96	[0.53; 1.74]	0.89
Bilateral hernia (*n*, %)*	1373 (19.7)	74 (28.2)	0.47	[0.34; 0.64]	<0.001
Emergency surgery for incarcerated hernia (*n*, %)*	22 (0.3)	5 (1.9)	0.10	[0.03; 0.34]	0.003
Surgical technique (*n*, %)					
Open	3600 (51.6)	143 (54.6)	0.74	[0.54; 1.03]	0.07
Type of anesthesia (*n*, %)*					
Spinal anesthesia	131 (1.9)	28 (10.8)	0.27	[0.16; 0.45]	<0.001
Early postop complications (*n*, %)*	72 (1)	34 (13)	0.07	[0.05; 0.12]	<0.001

Adjusted *p* values were included in the table

Table 8 Causes of ambulatory failure

Ambulatory failure	Laparoscopic GHR	Open GHR	Total
Total no. of patients (*n*, %)	119 (45.4)	143 (54.6)	262
Pain	7 (5.9)	34 (23.8)	41 (15.7)
Acute urinary retention	8 (6.7)	18 (12.6)	26 (9.9)
Fainting, headache	23 (19.3)	31 (21.6)	54 (20.6)
Vomiting	6 (5)	5 (3.5)	11 (4.2)
Bleeding	7 (5.9)	5 (3.5)	12 (4.6)
Stress	3 (2.5)	6 (4.2)	9 (3.5)
Supporting problem	9 (7.6)	11 (7.7)	20 (7.6)
Late check-out from OR	8 (6.7)	1 (0.7)	9 (3.4)
Other causes	38 (32)	20 (14)	58 (22.1)
Multiple causes	10 (8.4)	12 (8.4)	22 (8.4)

OR operating room

European Hernia Society considers day-surgery for inguinal hernia repair (IHR) to be safe, feasible and cost-effective [2]. Recommendations are that every patient should be considered for 1-day IHR. Expected benefits of ambulatory care are quicker mobilization, better patient satisfaction, reduction of infections and thromboembolic complications and cost reduction. Ambulatory practice is increasing all around the world. In the literature, various ambulatory rates have been reported. They ranged from 33 to 35%, respectively, in Spain and in the Netherlands in the early 2000s [7]. In Sweden, the national registry reported rates around 75%. In Denmark, this rate has risen from 55 to 70% between 1998 and 2005 [7]. The French article of Ngo et al. concluded that about 90% of groin and ventral hernia repair could be performed in an outpatient setting [8]. More recently, an Italian study reported a rate of 76% of outpatient procedures concerning unilateral inguinal hernia repair in comparison with a rate of 43% for femoral hernia repair [9]. In our series, 6974 patients (74.7%) were treated in an outpatient setting for GHR. This rate increased gradually from 65 to 75% between 2011 and 2015 but tends to stabilize probably because of restrictions imposed by the HAS (unfit for ambulatory if ASA grade ≥ III unstable, supporting problems or long distance from the hospital). Likewise, in our registry, the ambulatory rates varied from surgeon to surgeon, growing from 15.8 to 100%. This consideration potentially reflects local surgical practice and logistics from one center to the other but the comparison of the different centers in the analysis did not greatly impact the results. In 2014, French national data from the "Programme de Médicalisation des Systèmes d'Information" reported ambulatory rates of 56 and 68%, respectively, for open and laparoscopic GHR [1]. Laparoscopic bilateral IHR ambulatory rates decreased to 56%.

It is important to notice that the ambulatory success rate was higher than 96% as only 3.6% of the patients initially selected for ambulatory failed. We highlighted that several factors could impact the achievement of a 1-day procedure. ASA grade ≥ III was identified to be predictive of ambulatory failure (OR 0.43, $p < 0.01$) whereas increasing age did

Table 9 Comparison of patients selected and not selected for ambulatory upon multivariate analysis

	Selected for ambulatory	Not selected for ambulatory	OR	95% CI	*p*
Total no. of patients (*n*, %)	7236	2094	–	–	–
Age (years)*	59.2 ± 16.05	70.7 ± 14.8	0.96	[0.96; 0.97]	< 0.001
Gender (*n*, %)*					
Male	6476 (89.5)	1769 (84.5)	1.81	[1.50; 2.19]	< 0.001
BMI (kg/m^2)	25 ± 4.4	25.3 ± 4.2	1	[0.99; 1.02]	0.36
ASA grade ≥ III (*n*, %)*	446 (6.1)	902 (43)	0.16	[0.14; 0.19]	< 0.001
Physical occupation (*n*, %)	2603 (36)	404 (19.3)	0.98	[0.84; 1.14]	0.79
Intensive sport practice (*n*, %)*	1537 (21.2)	164 (7.8)	1.65	[1.36; 2.00]	< 0.001
History of hernia (*n*, %)	1383 (19.1)	511 (24.4)	0.87	[0.74; 1.02]	0.08
Recurrence of hernia (*n*, %)*	445 (6.1)	208 (9.9)	0.62	[0.49; 0.78]	< 0.001
Bilateral hernia (*n*, %)*	1447 (20)	527 (23.9)	0.47	[0.41; 0.54]	< 0.001
Emergency surgery for incarcerated					
Hernia (*n*, %)*	27 (0.4)	89 (4.3)	0.09	[0.05; 0.15]	< 0.001
Surgical technique (*n*, %)*					
Open	3743 (51.7)	1350 (64.5)	0.53	[0.47; 0.61]	< 0.001
Type of anesthesia (*n*, %)*					
Spinal anesthesia	159 (2.2)	192 (9.3)	0.58	[0.44; 0.76]	< 0.001

Adjusted *p* values were included in the table

Table 10 Causes of unselection for ambulatory surgery

Ambulatory not proposed	Laparoscopic GHR	Open GHR	Total
Total no. of patients	744	1350	2094
Supporting problem	183 (24.6)	272 (20.1)	455 (21.7)
Comprehension/social problem	13 (1.7)	81 (6)	94 (4.5)
Distance from hospital	52 (7)	73 (5.4)	125 (6)
Combined act	36 (4.8)	56 (4.1)	92 (4.3)
Ambulatory unavailable	10 (1.3)	11 (0.8)	21 (1)
ASA ≥ III	119 (16)	465 (34.4)	584 (27.9)
Sleep-disordered breathing	10 (1.3)	3 (0.2)	13 (0.6)
Medication relay	38 (5.1)	43 (3.2)	81 (3.9)
Other causes	158 (21.2)	156 (11.5)	314 (15)
Multiple causes	125 (16.8)	190 (14.1)	315 (15.1)

not—upon multivariate analysis. Palumbo et al. compared post-operative results of patients older than 80 and patients younger than 45 operated on for inguinal hernia repair (Lichtenstein technique with mesh fixation by glue under local anesthesia). The post anesthesia discharge score system and post-operative complications were not statistically different between the two groups. They concluded that age alone should not be a contraindication to outpatient surgery for inguinal hernia repair [10]. Amato et al. also reported comparable complication rates and unplanned admissions after inguinal hernia repair in the elderly despite a higher rate of comorbidities in this population [11]. Patients were operated on with a mesh and plug repair or Lichtenstein technique. Procedures were performed under deep sedation combined with a block of local anesthesia for ASA grades I and II whereas deep sedation was not employed among ASA grade III and IV patients. In France, patients with ASA grade III unstable or IV are considered to be unsuitable for outpatient hernia repair. Conversely, Sanjay et al. showed that ASA grades III and IV patients had similar post-operative complications (urinary retention, hematoma, infection, seroma) or readmission rates as ASA grade I and II patients, particularly when surgery for inguinal hernia repair was performed under local anesthesia [12]. These data suggest that ASA grade III and IV patients should not be strictly excluded from ambulatory IHR.

We also identified bilateral hernia repair to be predictive of 1-day surgery failure. 70% of bilateral GHR were outpatient procedures compared with 76% for unilateral hernia repair ($p < 0.001$). This may be explained in part

by the encouragement of the French health care system to maximize ambulatory procedures for unilateral GHR leaving out recommendations concerning bilateral GHR. One of the potential solutions to improve the rate of outpatient procedures could be to increase the use of laparoscopy for bilateral GHR (60% of bilateral GHR were performed using laparoscopic approach) although laparoscopic approach was not identified to facilitate the achievement of 1-day surgery.

The use of laparoscopic or open GHR was decided by the surgeon preoperatively. Some situations may particularly influence the surgeon to use laparoscopic approach for GHR (bilateral GHR, obese patients, recurrent hernia after open approach). This selection can be skewed by the fact that some surgeons do not use laparoscopy for GHR. The decision to use an open approach influenced the surgeon to not select patients for ambulatory care, probably because the use of this approach was more common among older patients.

Additionally, ambulatory rates appeared to be different among open procedures. The use of a posterior prosthetic repair was associated with a higher rate of outpatient procedures (80%) than other open procedures. This is probably the consequence of the major use of posterior prosthetic repair in a single center with surgeons particularly enthusiastic about outpatient surgery.

The occurrence of an early post-operative complication was highly associated with a risk of ambulatory failure (OR 0.08, $p < 0.01$). Medical complications, such as urinary retention, cardiovascular or neurological disorders, or surgical complications were considered as early post-operative complications. Urinary retention was the principle medical complication among inpatients and was found to be the cause of 10% of all ambulatory failures, more frequently after open GHR. The type of anesthesia used for some open GHR (spinal anesthesia) could be involved in this type of complication. Occurrence of medical complications was more common after open GHR. This consideration could be explained by the fact that patients undergoing open GHR were older and had more comorbidities than patients operated on by laparoscopy. Surgical complications were more serious, according to the Clavien & Dindo classification, after open GHR [6].

Surgical site collections occurred in 427 patients (4.5%) but mainly consisted in uninfected collections (seroma, hematoma), appearing a few days after surgery, explaining that this kind of complication was more frequently noticed among inpatients. Occurrence of infected collections did not differ between outpatient and inpatient procedures; this type of complication commonly appears later and does not influence length of stay.

Data concerning readmissions were not collected as such in the database and thus could not be mentioned.

2094 patients (21.5%) were not selected for an outpatient procedure preoperatively. More than 25% were not selected by the team for a one-day procedure because of organizational or social issues (supporting problem, comprehension or social problem, distance from hospital, combined act during the same hospital stay). 28% were contraindicated because of an ASA grade ≥ III. Such considerations are not necessarily absolute contraindications for outpatient surgery or alternative solutions can be proposed to the patients to make day-surgery possible. Age was not proposed in the questionnaire submitted to the surgeons as a reason for not proposing ambulatory.

Ambulatory failures were mainly caused by pain (15.7%), urinary retention (9.9%) or fainting/headache (20.6%), and occurred more frequently after open GHR. Failures were more often resulting from medical complications, sometimes related to comorbidities, than surgical causes.

All the above suggests that it is still possible to increase the rate of outpatient procedures for GHR. Surgeons and anesthesiologists must consider the patient in its entirety and tailor the right surgical approach and type of anesthesia to each patient. As an example, spinal anesthesia should be avoided in case of a urological history or preoperative difficulties in passing urines if outpatient surgery is envisaged. Age and ASA grade should not be the only factors to contraindicate outpatient GHR. A better organization of the patient's living environment and an adapted post-operative support may improve ambulatory rates for GHR. Organizational criteria for ambulatory care could become less restrictive in the future.

Conclusion

Based on a large scale multicenter database of 9330 patients operated on for GHR, we could assess the French outpatient surgery practice. Only 3.6% of the patients selected preoperatively for ambulatory care failed. ASA grade ≥ III, bilateral hernia repair, emergency surgery for incarcerated hernia, spinal anesthesia and the occurrence of an early post-operative complication were identified as predictive factors of ambulatory failure. An ambulatory setting was potentially not proposed preoperatively because of wrongly restrictive criteria which do not endanger the patient. The eligible ambulatory rated could increase making organizational rules more flexible.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical approval All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Human and animal rights I hereby undersign and certificate that this article does not contain any studies with animals performed by any of the authors.

Informed consent Informed consent was obtained from all individual participants included in the study.

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