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ORIGINAL SCIENTIFIC REPORT

# Nationwide Analysis of Urinary Retention Following Inguinal Hernia Repair: Results from the National Prospective Hernia Registry

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## Abstract

*Background* Urinary retention is one of the most common early postoperative complications following inguinal hernia repair (IHR). The aim of this study was to assess the incidence of postoperative urinary retention (POUR) and to identify associated risk factors.

*Method* Data of consecutive patients undergoing IHR from 2011 to 2017 were collected from a national multicenter cohort. POUR was defined as the inability to void requiring urinary catheterization. A multivariate analysis was conducted to identify independent risk factors for POUR.

*Results* Of 13,736 patients, 109 (0.8%) developed POUR. Patients with POUR had longer hospital length of stay ($p < 0.001$). IHR was performed by a laparoscopic or an open approach in 7012 (51.3%) and 6655 (48.7%) patients, respectively, and spinal anesthesia was realized in 591 (4.3%) patients. Ambulatory surgery was performed in 10,466 (76.6%) patients. Multivariate analysis identified preoperative dysuria (0R 3.73, $p < 0.001$), diabetes mellitus (OR 1.98, $p = 0.029$) and spinal anesthesia (OR 7.56, $p < 0.001$) as independent preoperative risk factors associated with POUR. POUR was the cause of ambulatory failure in 35 (10.2%) patients who required unanticipated admission.

*Conclusion* The incidence of POUR following IHR remains low but impacts hospitalization settings. Preoperative risk factors for POUR should be considered for the choice of the anesthetic technique.

## Introduction

Inguinal hernia repair (IHR) is a common intervention practiced in daily routine by general surgeons. Approximately 75% of the patients can be managed in an ambulatory setting following IHR [1, 2]. Postoperative urinary retention (POUR) is one of the most frequent early

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complication following IHR with a reported incidence ranging from 0 to 22% [3–11].

POUR is commonly managed by bladder catheterization and can lead to further complications related to the catheter placement such as urinary tract infections or urethral trauma [12]. Moreover, it has been previously reported that almost 10% of the ambulatory failures are due to the occurrence of POUR. Unanticipated admission can be justified by the pain related to urinary catheterization and/or the surveillance until the resumption of spontaneous voiding following the removal of urinary catheter [2]. POUR prolongs the length of hospital stay and increases health-related costs [5, 7].

Numerous risk factors related to the patients (age, body mass index, benign prostatic hypertrophy) or the procedures (type of anesthesia, perioperative fluid administration, bilateral hernia repair, mesh fixation, operative time, narcotic analgesia) were previously identified to be associated with the occurrence of POUR, but the conclusions of the different studies are heterogenous and sometimes contradictory. This can be explained by the lack of standardized definition of POUR and an heterogeneity in patient characteristics, anesthetic protocols and surgical techniques. Moreover, these studies are mainly based on small series of patients and/or limited to a single surgical approach performed in the same institution.

The aim of this multicenter cohort study was to determine the incidence and the risk factors for POUR following IHR.

## Methods

### Study population

This study was a retrospective review of a prospectively maintained multicenter cohort. A large-scale database concerning IHR 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 inguinal hernia surgery. All consecutive patients undergoing IHR by the members of the French «Club Hernie» between June 2011 and December 2017 were included in the database. Data collected were encrypted and anonymized in accordance with the French national ethical standards. The Club Hernie registry is approved by the French "Commission Nationale de l'Informatique et des Libertés" (CNIL Registration Number 1993959v0).

Patients who underwent IHR in emergency for incarcerated hernia or patients with missing data concerning preoperative symptoms (asymptomatic hernia, discomfort, pain or incarceration) or postoperative course (occurrence of postoperative complications) were excluded. The cohort was divided into two groups according to the occurrence of POUR. Preoperative and postoperative data were compared between the two groups.

### Surgical procedure

Procedures were performed by 55 general surgeons. Patients were seen preoperatively by the surgeon and the anesthesiologist. At the time of the anesthetic consultation, the American Society of Anesthesiology (ASA) grade and the type of anesthesia were determined. The choice of the surgical technique was left to the discretion of the surgeon. Procedures included open and laparoscopic repairs. Open techniques could be performed using a prosthetic reinforcement or prosthesisfree. Laparoscopic techniques consisted in TransAbdominal PrePeritoneal (TAPP) or Totally ExtraPeritoneal (TEP) approaches.

IHR could be performed as an outpatient or inpatient surgery. Outpatients were admitted in the morning and discharged following IHR if they (1) were preoperatively selected for an ambulatory setting and (2) gathered the required conditions for an outpatient procedure: normal vital signs, absence of bleeding or pain, oral intake, walk without assistance and spontaneous voiding. Failure of the ambulatory setting was defined as an unplanned admission in the surgical department for further care following surgery.

Each patient visited the surgeon one month after surgery or before if necessary.

### Data collection

Collected data included patient characteristics (age, sex, body mass index), comorbidities (preoperative dysuria, diabetes mellitus, steroids intake, smoking, ASA grade), hernia characteristics (preoperative symptoms, unilateral or bilateral, primary or recurrence), procedures (surgical technique, type of anesthesia, operative time) and postoperative outcomes (outpatient or inpatient setting, length of stay, complications). Preoperative dysuria was diagnosed if at least one of the four following criteria was present: the need to push in order to urinate, >2 urinations per night, a week urine stream or a significant delay before passing urine. Complications were divided into medical complications, surgical site collections (SSC) and surgical complications. Complications were considered as severe when the Clavien–Dindo score was ≥III [13]. POUR was defined by the association of the inability to urinate following surgery and the need for bladder catheterization to relieve the symptoms.

Data concerning patient characteristics were collected preoperatively. Preoperative data and postoperative items

were collected during the follow-up. Postoperative 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.

### Statistical analyses

Statistical analyses were performed using Statview software (version 5.0; Statview, SAS Institute Inc, Cary, NC). Quantitative data were expressed as median (interquartile). Categorical values were expressed as *n*(%). Comparison of qualitative and quantitative data was performed using a Fischer's exact test and the Student's *t* test, respectively. In order to identify independent preoperative risk factors for POUR, patient characteristics associated with POUR at a $p$ value $< 0.10$ in univariate analysis were included in a multivariate analysis. Operative time was not included in the multivariate analysis because unknown before surgery. The multivariate analysis was performed using a logistic regression model. Comparisons were considered significant at a $p$ value $< 0.05$.

## Results

From a cohort of 17,005 IHR, 13,736 patients were included in the study (Fig. 1). The cohort included 12,183 (88.7%) males, and the median age was 66 (54–75) years (Table 1). ASA grade was ≥III in 1,748 (12.7%) patients. Three thousands and ninety-nine (22.6%) patients underwent a bilateral hernia repair. Patients were mainly operated on under general anesthesia, but 591 (4.3%) patients underwent a spinal anesthesia. IHR was performed using an open approach in 7012 (51.3%), TAPP in 3708 (27.1%) or a TEP in 2947 (21.6%) patients. Open anterior prosthetic repairs mainly consisted in Lichtenstein technique in 2585 (18.8%) patients, whereas open posterior prosthetic reinforcements were dominated by TIPP in 2807 (20.4%) patients.

Nine hundred and sixty-nine (7.1%) patients experienced a postoperative complication including 66 (0.5%) severe complications (Table 2). POUR was reported in 109 (0.8%) patients, being the second most frequent complication behind surgical site infections (4.7%). Patients with POUR were older (74 vs 66 years, $p < 0.001$) and presented with more comorbidities (36.7 vs 12.5% of patients with ASA grade ≥III, $p < 0.001$) (Table 1). POUR patients suffered more frequently from preoperative dysuria (27.8 vs 5.3%, $p < 0.001$) and diabetes mellitus (11.9 vs 4.5%, $p = 0.001$). POUR occurred more frequently following open IHR than after laparoscopic procedures (72.9 vs 51.2, $p < 0.001$ for open procedures). Operative time was longer in POUR patients (35 vs 30 min, $p = 0.017$).

A total of 10,466 (76.6%) patients had ambulatory surgery. The median length of stay was prolonged in POUR patients (1 day vs 0, $p < 0.001$) (Table 3). Outpatient rate was significantly lower in the POUR group (22.6% vs 77.1%, $p < 0.001$). An unplanned admission for ambulatory failure was required in 343 patients initially planned for ambulatory surgery. Unplanned admission was justified by isolated POUR in 30 (8.7%) patients and POUR associated with pain, fainting, stress or late checkout from the operating room in 5 (1.5%) patients. Other major causes of ambulatory failure were fainting or headache in 71 patients (20.7%), pain in 60 patients (17.5%) and socio-organizational issues in 39 patients (11.4%).

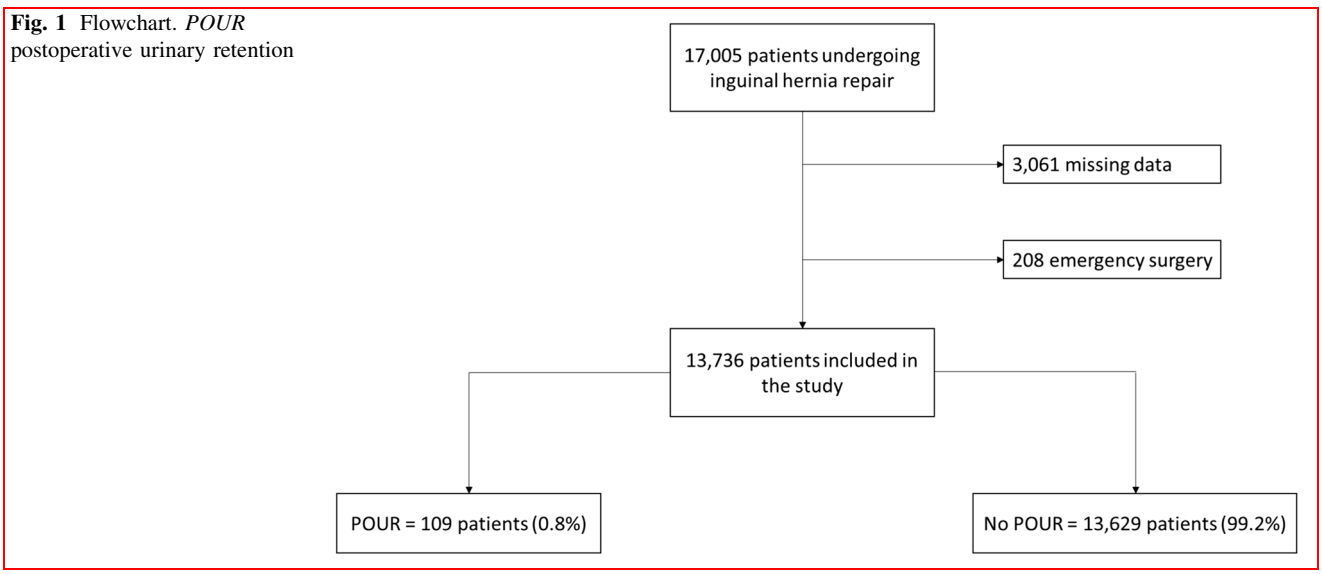



**Fig. 1** Flowchart. *POUR* postoperative urinary retention

**Table 1** Perioperative characteristics

| | Total ($n$ = 13,736) | POUR ($n$ = 109) | No POUR ($n$ = 13,627) | $p$ |
|---|---|---|---|---|
| Age, median (IQ)† | 66 (54–75) | 74 (68–82) | 66 (54–75) | < 0.001 |
| Missing data | 52 | 0 | 52 | |
| Male gender | 12,183 (88.7) | 103 (94.5) | 12,080 (88.6) | 0.067 |
| Missing data | 0 | 0 | 0 | |
| BMI, median (IQ† | 24.7 (22.8–26.8) | 25.2 (23.1–27.5) | 24.7 (22.8–26.8) | 0.125 |
| Missing data | 135 | 1 | 134 | |
| Smoker | 2615 (19.2) | 12 (11.1) | 2603 (19.3) | 0.036 |
| Missing data | 129 | 1 | 128 | |
| Preoperative dysuria | 750 (5.5) | 30 (27.8) | 720 (5.3) | < 0.001 |
| Missing data | 74 | 1 | 73 | |
| Diabetes mellitus | 624 (4.6) | 13 (11.9) | 611 (4.5) | 0.001 |
| Missing data | 98 | 0 | 98 | |
| Corticosteroids | 179 (1.3) | 4 (3.7) | 175 (1.3) | 0.055 |
| Missing data | 98 | 0 | 98 | |
| ASA grade | | | | < 0.001 |
| I | 6698 (48.9) | 26 (23.8) | 6672 (49.1) | |
| II | 5256 (38.4) | 43 (39.5) | 5213 (38.3) | |
| III | 1730 (13.6) | 39 (35.8) | 1691 (12.5) | |
| IV | 18 (0.1) | 1 (0.9) | 17 (0.1) | |
| Missing data | 34 | 0 | 34 | |
| Inguino-scrotal hernia | 1405 (10.3) | 15 (13.9) | 1390 (10.3) | 0.205 |
| Missing data | 105 | 1 | 104 | |
| Recurrent hernia | 1022 (7.5) | 9 (8.2) | 1013 (7.5) | 0.714 |
| Missing data | 84 | 0 | 84 | |
| Bilateral hernia repair | 3099 (22.6) | 30 (27.8) | 3069 (22.6) | 0.205 |
| Missing data | 55 | 1 | 54 | |
| Surgical technique | | | | < 0.001 |
| Open prosthetic repair | 6602 (48.3) | 75 (70.1) | 6527 (48.2) | |
| Open non-prosthetic | 410 (3.0) | 3 (2.8) | 407 (3.0) | |
| TAPP | 3708 (27.1) | 14 (13.1) | 3694 (27.3) | |
| TEP | 2947 (21.6) | 15 (14.0) | 2922 (21.5) | |
| Missing data | 79 | 2 | 77 | |
| Anesthetic technique | | | | < 0.001 |
| General anesthesia | 12,707 (93.5) | 70 (65.4) | 12,637 (93.7) | |
| Spinal anesthesia | 591 (4.3) | 37 (34.6) | 554 (4.1) | |
| Local anesthesia | 296 (2.2) | 0 | 296 (2.2) | |
| Missing data | 142 | 2 | 140 | |
| Operating time, median | | | | 0.017 |
| (IQ) | 30 (20–40) | 35 (27–45) | 30 (20–40) | |
| Missing data | 139 | 3 | 136 | |

*IQ* interquartile, *BMI* body mass index, *ASA* American society of anesthesiology, *TAPP* TransAbdominal PrePeritoneal, *TEP* Totally Extra Peritoneal

Data expressed as $n$(%) except † expressed as median (interquartile)

Multivariate analysis identified 3 preoperative risk factors independently associated with POUR: preoperative dysuria (OR 3.73, $p < 0.001$), diabetes mellitus (OR 1.98, $p = 0.029$), and spinal anesthesia (OR 7.56, $p < 0.001$) (Table 4). Advanced age, male gender, operative time and surgical approach did not impact POUR rates.

**Table 2** Postoperative complications

| | Total ($n$ = 13,736) |
|---|---|
| Overall morbidity | 969 (7.1) |
| Missing data | 52 |
| Severe complications | 66 (0.5) |
| Missing data | 65 |
| Medical complications | 261 (1.9) |
| Missing data | 0 |
| Postoperative urinary retention | 109 (0.8) |
| Phlebitis/lymphangitis | 43 (0.3) |
| Broncho-pulmonary | 18 (0.1) |
| Surgical site collections | 640 (4.7) |
| Missing data | 30 |
| Surgical complications | 127 (0.9) |
| Missing data | 48 |
| Ischemic orchitis | 24 (0.2) |
| Vascular injury | 7 (0.05) |
| Intestinal injury | 2 (0.01) |

Data expressed as $n$ (%). Only the most frequent complications were detailed

**Table 4** Multivariate analysis of preoperative risk factors for postoperative urinary retention

| | OR (95%CI) | $p$ |
|---|---|---|
| Age (per 10 years) | 1.02 (1.00–1.03) | 0.053 |
| Male gender | 0.63 (0.27–1.47) | 0.291 |
| Smoker | 0.69 (0.37–1.31) | 0.260 |
| Preoperative dysuria | 3.73 (2.29–6.07) | < 0.001* |
| Diabetes | 1.98 (1.07–3.68) | 0.029* |
| Corticosteroids | 1.93 (0.67–5.58) | 0.224 |
| ASA grade | | |
| I–II | Ref | 0.093 |
| III–IV | 1.50 (0.93–2.40) | |
| Surgical technique | | |
| Open prosthetic | Ref | |
| Open non-prosthetic | 0.73 (0.22–2.44) | 0.608 |
| TAPP | 0.69 (0.37–1.28) | 0.242 |
| TEP | 0.94 (0.52–1.73) | 0.853 |
| Anesthetic technique | | |
| General anesthesia | Ref | |
| Spinal anesthesia | 7.56 (4.68–12.22) | < 0.001* |
| Local anesthesia | 0.00 (0.00 ≥ 99) | 0.996 |

*Statistically significant results

*ASA* American Society of Anesthesiology, *TAPP* TransAbdominal PrePeritoneal, *TEP* Totally ExtraPeritoneal

The accumulation of risk factors increased gradually the risk of POUR from 0.4, to 2.4%, 10.5% and 50% in patients with 0, 1, 2 or 3 risk factors, respectively (Fig. 2). Diabetic patients and patients suffering from preoperative dysuria had a higher risk of POUR if they underwent spinal anesthesia, increasing from 0.3% to 12.5% ($p < 0.001$) and from 3.9% to 10% ($p < 0.001$), respectively.

A practical algorithm, aiming to guide the practitioners in the case of POUR following inguinal hernia repair, is presented in Fig. 3.

## Discussion

This large multicenter study confirms that POUR remains a rare complication following IHR, occurring in less than 1% of patients. However, POUR appears to be the second most frequent complication behind surgical site infections (4.7%). The risk of POUR can be predicted by three risk factors including preoperative dysuria, diabetes mellitus and spinal anesthesia. The incidence of POUR strongly increases to 8–50% in patients cumulating at least 2 risk factors for POUR.

Previous studies reported variable rates of POUR following IHR ranging from 0 to 22%. These variations can be explained by heterogenous definitions of POUR and selected surgical procedures [3–11]. In the whole cohort, POUR was consensually defined as the inability to urinate requiring bladder catheterization to relieve the symptoms.

The patients undergoing IHR were included consecutively thus reflects routine surgical practice with a large

**Table 3** Postoperative outcomes

| | Total ($n$ = 13,736) | POUR ($n$ = 109) | No POUR ($n$ = 13,627) | $p$ |
|---|---|---|---|---|
| Hospital stay, median (IQ)† | 0 (0–0) | 1 (1–2) | 0 (0–0) | < 0.001 |
| Missing data | 505 | 5 | 500 | |
| Outpatient surgery | 10,466 (76.6) | 24 (22.6) | 10,442 (77.1) | < 0.001 |
| Missing data | 79 | 3 | 76 | |

*IQ* interquartile

Data expressed as $n$ (%) except † expressed as median (interquartile)

panel of surgical procedures. The rate of open (51%) and laparoscopic (49%) hernia repairs is quite balanced, and the surgical approach was not found to impact the occurrence of POUR.

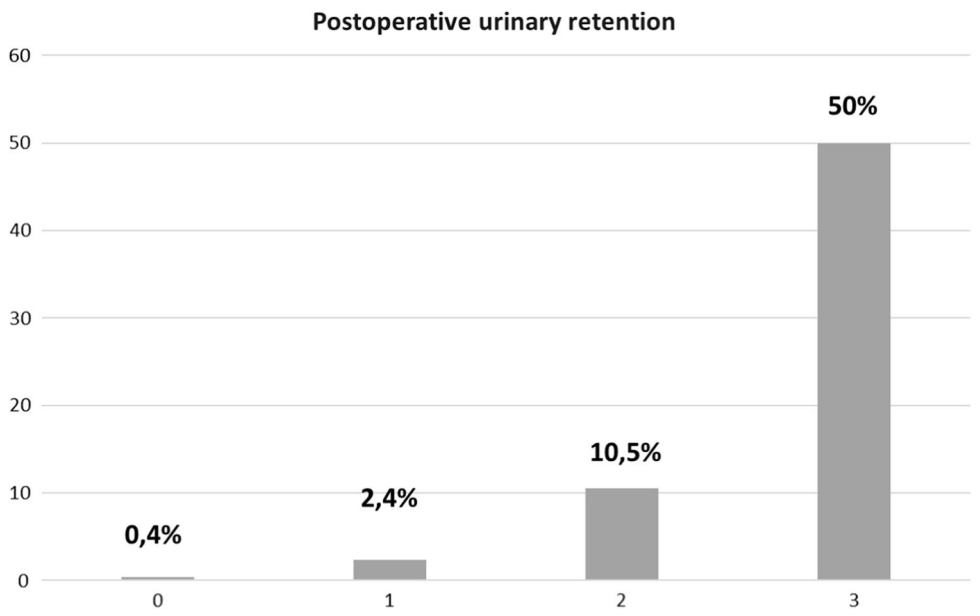
One of the four predictive factors of POUR identified in this study are modifiable risk factors. The multivariate analysis demonstrated that the anesthetic technique was the most significant risk factor for POUR. Spinal anesthesia was associated with an eightfold increase in the rate of POUR. In the retrospective study of Blair et al., only ten patients underwent spinal anesthesia which tended to increase the risk of POUR [11]. A review comparing anesthetic techniques found a lower incidence of urinary retention with local anesthesia (0.37%) as compared to regional (2.42%) or general anesthesia (3%) [6]. Spinal anesthesia is known to promote urinary retention via an interruption of the micturition reflex and then a detrusor blockade. Spinal anesthesia can prove benefit to prevent postoperative complications in patients with respiratory or cardiac severe conditions. The incidence of the retentions could be reduced in these populations by using short-acting agents or modifying the anesthetic technique in favor of epidural anesthesia [14, 15]. We did not have data in our cohort on the association of morphine derivated with local anesthetic for spinal anesthesia, but sufentanil is frequently added to bupivacaine to prolong the sensory and motor blockades in spinal anesthesia. The short duration of the surgical procedure (<35 min) suggests that the addition of morphine derivates can probably be avoided to prevent POUR after IHR.

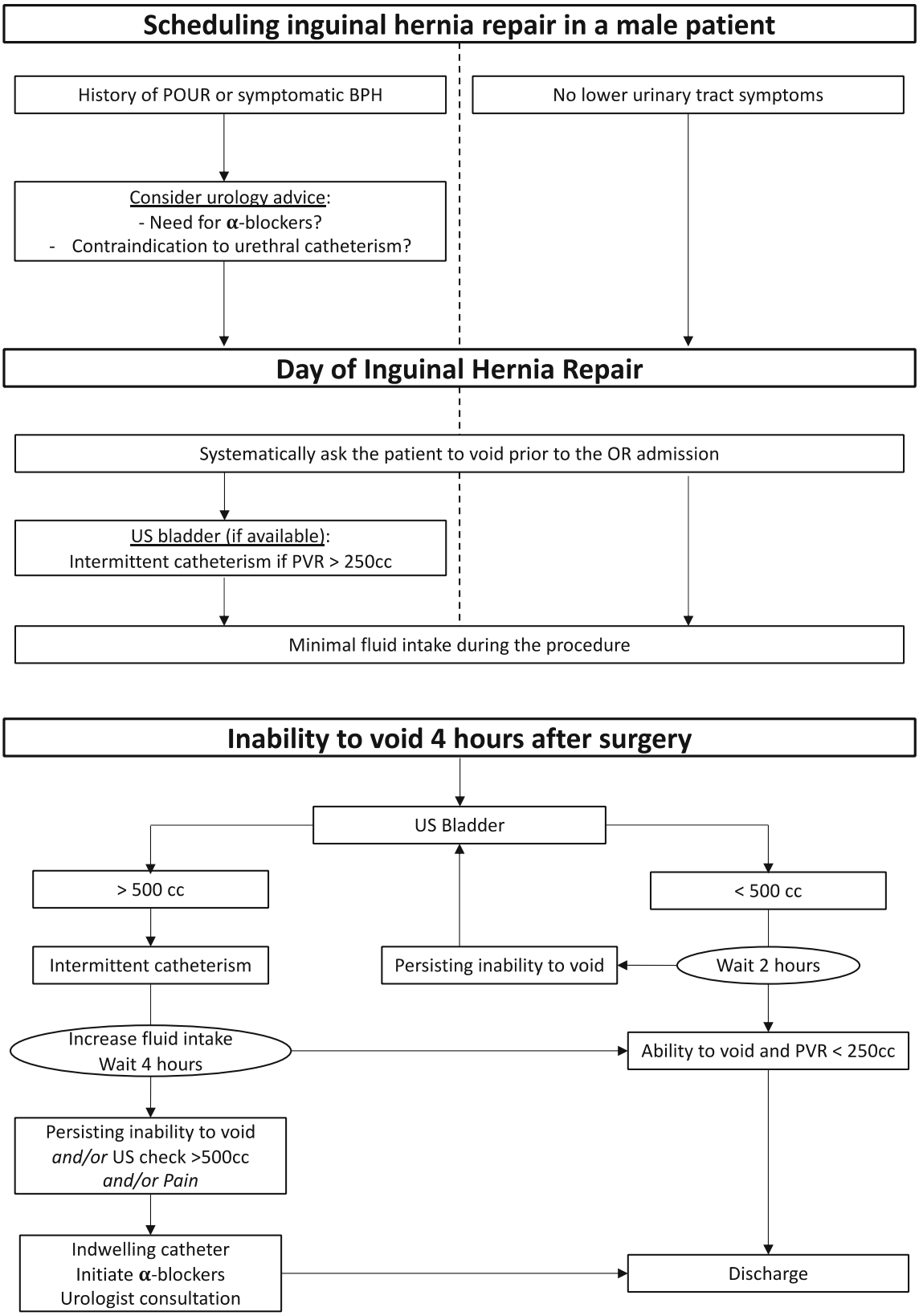
Preoperative dysuria was also identified as an independent risk factor for POUR. The physiological mechanism of POUR is in part related to an alpha-adrenergic overstimulation caused by the combination of catecholamines release during surgery, the use of sympathomimetic/anticholinergic anesthetic agents and local pain following surgery. Alpha-blockers are suspected to decrease surgery-related alpha-adrenergic overstimulation. A recent meta-analysis gathered the results of five prospective studies comparing the urinary retention rates in patients receiving alpha-blockers or a placebo prior to inguinal hernia surgery [16]. The use of prophylactic alpha-blockers resulted in a significant decrease of POUR from 24.3% in the control group to 3.7% in treated patients (OR 0.179; $p = 0.018$) without serious adverse effects. According to these results, alpha-blockers could be proposed systematically before surgery in patients presenting with preoperative urinary dysfunction.

This is the first study to identify diabetes mellitus as an independent risk factor for POUR following IHR. In diabetic patients, peripheral neuropathy can be responsible of diabetic cystopathy, affecting 25 to 80% of the patients [17]. Diabetic cystopathy is characterized by impaired bladder sensation, increased post-void residual urine, increased bladder capacity and decreased bladder

**Fig. 3** Suggested algorithm for prevention and management of postoperative urinary retention following inguinal hernia repair. *POUR* postoperative urinary retention, *BPH* benign prostate hyperplasia, *PVR* postvoid residual volume. Urology advice should be considered before discharge following POUR and indwelling catheter placement. An appointment with the urologist must be scheduled for catheter removal at POD 3 to 7 in order to check the ability to void. Overnight catheterization in the hospital and removal at POD 1 can also be discussed

**Fig. 2** Proportion of postoperative urinary retention according to the number of risk factors




Scheduling inguinal hernia repair in a male patient
History of POUR or symptomatic BPH
No lower urinary tract symptoms
Consider urology advice:
- Need for α-blockers?
- Contraindication to urethral catheterism?
Day of Inguinal Hernia Repair
Systematically ask the patient to void prior to the OR admission
US bladder (if available):
Intermittent catheterism if PVR > 250cc
Minimal fluid intake during the procedure
Inability to void 4 hours after surgery
US Bladder
> 500 cc
< 500 cc
Intermittent catheterism
Persisting inability to void
Wait 2 hours
Increase fluid intake
Wait 4 hours
Ability to void and PVR < 250cc
Persisting inability to void
and/or US check >500cc
and/or Pain
Indwelling catheter
Initiate α-blockers
Urologist consultation
Discharge

contractility. The diabetes-related bladder dysfunction could easily explain the higher rate of POUR in diabetic patients. The choice of the spinal anesthesia should be balanced with the risk of POUR in diabetic patients.

POUR caused about 10% of the ambulatory failures of the present series and then prolonged the hospital stay. As a comparison, Pavlin et al. estimated that 5 to 19% of the outpatients after anal or hernia surgery had their discharge delayed because of POUR [18]. Preoperative identification of high-risk patients associated with preparation with alpha-blockers and avoidance of spinal anesthesia could help to reduce the rate of ambulatory failures. One solution to decrease hospital stay in patients with POUR would be to propose intermittent catheterization instead of systematic indwelling catheterization. Intermittent catheterization every 6 h allows to stop urinary catheterization as soon as urinary dysfunction recovers. Contradictory results about the adequate management of POUR were obtained in previous studies. One randomized trial is recommended to perform an overnight catheterization rather than intermittent catheterization in order to prevent the risk of catheter removal failure [19]. Indeed, 27.7% of the patients required further catheterization in the case of intermittent catheterization, whereas less than 5% failed after withdrawal of the catheter when they were kept with the catheter overnight. Lau et al. found no significant differences between the two strategies [20]. Nevertheless, these findings seems to encourage a more frequent monitoring of bladder volume, every 4 h, with the need to void using intermittent catheterization if superior to 500 mL as proposed by Choi el al [21].

This study has several limitations. The analysis is based on a retrospective review of the data gathered in a multicenter registry. However, this database is prospectively and rigorously supplied, through 164 items, by the members of the Club Hernie with a blinded control by an independent data manager. Readmission rates within the first month after surgery were solely collected since 2015. As a consequence, the rate of post-discharge POUR could have been underestimated. This situation seems to be rare as only two cases of readmission for acute urinary retention were identified in a period of two years. The rate of preoperative urinary dysfunction could also have been underestimated due to the lack of systematic use of dedicated questionnaires such as IPSS to diagnose urinary dysfunction. Another limit is related to the non-inclusion in the analysis of previously identified risk factors for POUR such as fluid administration or narcotic analgesia because these data were not recorded in the registry.

## Conclusion

This national cohort study demonstrated that POUR is a rare complication following IHR but is associated with 10% of the ambulatory failures. The data highlighted that POUR can be predicted by the three independent risk factors: preoperative dysuria, diabetes mellitus and spinal anesthesia. Surgeons and anesthesiologists should identify high risk patients at the time of preoperative consultation and discuss together the choice of spinal anesthesia in this subgroup of patients.

### Compliance with ethical standards

**Conflict of interest** All the authors declare that they have no conflict of interest in relation with this study.

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