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## **Fecal impaction is associated with postoperative urinary retention after hip fracture surgery**

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## **Fecal impaction is associated with postoperative urinary retention after hip fracture surgery**

### **Abstract**

**Background.** Postoperative urinary retention (POUR) is a common hip fracture (HF) complication. Although fecal impaction (FI) is one of the oft-cited causes of POUR in clinical practice, evidence regarding this association is scarce.

**Objective.** The aim of this study was to determine whether FI was associated with POUR after HF surgery in older patients.

**Methods.** All patients consecutively admitted after a HF surgery in a geriatric perioperative unit were included in this cross-sectional study. FI was systematically assessed by a digital rectal exam at admission and according to clinical suspicion during the hospital stay. The dependent variable was POUR, systematically screened according to the department protocol and defined as a bladder volume > 400 ml requiring catheterization. The association between FI and POUR was assessed by multivariable analysis.

**Results.** A total of 256 patients were included (mean [SD] age 86 [6] years), 76% women): 108 (42%) presented FI and 63 (25%) POUR. The frequency of FI was higher with than without POUR (73% vs 32%,  $P<0.001$ ). On multivariable analysis, after adjusting for age, sex, Cumulative Illness Rating Scale score and anticholinergic load, FI was the only factor independently associated with POUR (odds ratio 4.78 [95% confidence interval 2.44-9.71],  $P<0.001$ ).

**Conclusions.** FI was the only independent factor associated with POUR after HF surgery in older adults. Further studies are needed to optimize perioperative geriatric care including FI and POUR assessment and management.

**Keywords.** Post-operative urinary retention; fecal impaction; hip fracture; older; lower urinary tract symptoms; rehabilitation

## **Introduction**

With the increase in the older population worldwide, the incidence of hip fracture (HF) is estimated to increase from 1.66 million in 1990 to 6.26 million by 2050[1]. HF has become a public health priority in developed countries: one third of older adults will die within a year after HF because of post-operative or bed rest complications[2]. Among survivors, 32% will be discharged directly to home following surgery and 23% to rehabilitation, finally allowing most patients to return home[3]. After rehabilitation, 83% of those without any impairment to 46% of those with combined impairment will return home[4]. The risk of mortality decreases for patients who have undergone intensive inpatient rehabilitation[5].

Postoperative urinary retention (POUR) is a common complication in HF patients, with an average prevalence ranging from 11% to 56%, depending on the POUR definition[6][7][8][9]. Most urinary retention episodes are asymptomatic and frequently underestimated[10]. However, POUR can also lead to adverse events such as urinary tract infections or delirium, which may extend the hospital length of stay[10]. In rehabilitation, the presence of urinary retention affects the recovery of mobility[7]. After HF surgery, elevated post-void residual urine volume significantly increases the risk of mortality within a year [11] and prolonged diapers or catheter use negatively affects the recovery of mobility in the initial post-operative period[12]. These urinary concerns have changed the urinary postoperative management, requiring an early and systematic assessment by measuring post-void residual volume. In previous studies involving older patients after HF surgery, opioids use [8], anticholinergic load [8], long period of indwelling urethral catheter [6], and preoperative neurocognitive disorder and/or delirium [6] were significantly associated with POUR.

Fecal impaction (FI) is common in older patients after HF [10] and is associated with several complications and poor quality of life [9]. Despite clinical evidence and guidelines for searching and treating FI as part of the usual care of adults with urinary retention [13], especially in neuro-urology fields [14], data are scarce about the association between FI and urinary retention. Indeed, studies are mainly conducted in pediatric populations [15] [16] [17] or nursing homes [18].

The aim of our study was to determine whether FI was associated with POUR after HF surgery in older patients.

## **Methods**

### ***Ethics***

This study complied with the recommendations of the Declaration of Helsinki. It was approved by the local ethics committee (GEROND'IF, gérontopôle d'Île-de-France). The database was declared to the French National Commission on Computing and Liberty (CNIL) of the Assistance Publique-Hôpitaux de Paris (no. 20190415163321). Some of the patients included in this study were also included in previous studies [10] [19] [20] [21]. This study follows the STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) guidelines. (Supplementary Data)

### ***Study design, participants and setting***

In this cross-sectional study, all patients consecutively admitted to our geriatric perioperative unit (UPOG) after HF surgery were assessed for eligibility. Exclusion criteria were multiple, metastatic, or periprosthetic fractures. The UPOG is devoted to the postoperative care of older adults with HF. The opening of this new geriatric unit was based on the aim to improve long-term mortality by an early and specific multidisciplinary management, focused on comorbidity

management and early rehabilitation of older patients with HF either directly from the emergency room or within 48 hr after surgery [10].

### **Dependent variable**

The primary endpoint was POUR, defined as a bladder volume  $> 400$  ml, requiring catheterization to empty the bladder. The bladder volume was assessed by using a portable ultrasound bladder scanner device (BladderScan BVI 9400, Verathon Medical, France), after the patient requested to void or after being asked to void. We followed the protocol of our UPOG department, which was based on a proposed protocol that screened voiding dysfunction for cognitive patients with iterative bladder assessments showing a never-emptied bladder with often larger bladder volume [22] because we could not measure a real post-void volume for our geriatric patients who are unable to say their desire to void because of a cognitive disorder or post-operative delirium. Bladder scanner measurements were systematically performed every 4 hr for each patient, except during sleeping hours. Additional assessments could be done if urinary retention was suspected. For patients admitted from the operating room or orthopedic department with an indwelling catheter, the catheter removal was systematically scheduled at the latest 12 hr after admission to UPOG. After catheter ablation, the bladder monitoring protocol was applied as for other patients. For all study participants, this assessment lasted as needed, depending on diuresis and bladder volume.

### ***Independent variables***

Baseline characteristics including age, sex, living status, functional status (using the Activities of Daily Living and Instrumental Activities of Daily Living scales), medical history and medications were collected. Comorbidities were assessed with the Cumulative Illness Rating Scale (CIRS 52) in which each co-occurring medical condition is ranked from 0 to 4 in 13 main independent body systems [23]. Anticholinergic load was calculated by using the

Anticholinergic Risk Scale (ARS), ranking medicines for anticholinergic activity on a scale of 0 to 3, with 0 indicating unknown anticholinergic activity and 3 high anticholinergic activity [24]. Polypharmacy was defined as > 4 medications per patient [25]. Surgical data were detailed and included the type of anesthesia, surgical procedure, and time to surgery. Post-operative complications, opioids use and constipation treatment during the hospital stay were recorded. Post-operative complications included FI, delirium, anemia, transfusion, infection, revision surgery, pressure sore, atrial fibrillation, myocardial infarction, acute heart failure, venous thromboembolism, and hospital death rate.

FI was defined as the inability to evacuate large, hard, inspissated, concreted stool or bezoar lodged in the lower gastrointestinal tract [26]. It was systematically screened by a digital rectal exam at admission in UPOG and in the absence of stool or bowel movements for > 3 days.

### ***Statistical analysis***

Statistical analysis involved using R 3.5.2 (R Development Core Team, <http://www.R-project.org>). A graphical method was used to assess the normality of each variable. Categorical variables were compared by chi-square test or Fisher exact test when the expected number was < 5. Quantitative variables with normal distribution were assessed by Student *t* test and by Wilcoxon test if non-normally distributed. Statistical significance was set at  $p < 0.05$ . Logistic regression models were used to assess the association between FI and POUR in multivariable analysis. Variables selected in the multivariable analysis model were potential confounders in this relationship, using a direct acyclic graph (Supplementary Figure)[27].



## Results

Among the 297 patients admitted, 256 were retained for the analysis (mean [SD] age 86 [6] years), 76% women) (Figure). Baseline characteristics according to POUR are in Table 1.

The mean (SD) CIRS 52 score was 10 (4). Overall, 107 (42%) and 243 (95%) patients had classical factors associated with POUR such as delirium or postoperative opioids use, respectively. A total of 41 (16%) patients had an ARS score > 0 (i.e., presence of anticholinergic medications). FI was diagnosed in 108 (42%) of participants (Supplementary Table).

A total of 63 (25%) participants had a diagnosis of POUR during a mean (SD) hospital stay of 10 (6) days, and 5% failed the trial without catheter. Participants with POUR had significantly more comorbidities than those without POUR, with mean (SD) CIRS 52 score 11 (4) and 10 (4), respectively ( $P=0.03$ ). FI was more frequent in patients with than without POUR (73% vs 32%,  $P<0.001$ ) as were postoperative complications such as blood transfusion (38% vs 23%,  $P=0.02$ ), pressure sores (22% vs 7%,  $P<0.001$ ), acute heart failure (22% vs 5%,  $P<0.001$ ) and intensive care unit referral (11% vs 4%,  $P=0.02$ ). In-hospital death was also higher in patients with than without POUR (6% vs 1%,  $P=0.03$ ).

Multivariable analysis models included potential confounders in the association between FI and POUR (Table 2). After controlling for age and sex, FI was significantly associated with POUR (Model 1,  $P<0.001$ ). When adjusting for comorbidities and anticholinergic load using the CIRS-52 and the ARS scores, respectively, the significant association between FI and POUR was sustained (Model 2,  $P<0.001$ ). In the fully adjusted Model 3, FI remained the only factor independently associated with POUR (odds ratio 4.78 [95% confidence interval 2.44-9.71],  $P<0.001$ ).

## **Discussion**

This is the first study exploring the association between FI and POUR in older adults hospitalized in a dedicated acute care unit after HF surgery. Patients with POUR were significantly more likely than those without POUR to have more comorbidities and other postoperative complications. However, FI was the only independent factor associated with POUR on multivariable analysis, with a nearly 5-fold increase in risk. This result is of great value in post-operative management in these patients with a high risk of complications that can affect their functional and vital prognosis.

### ***Association between FI and POUR***

In a previous study, in a geriatric rehabilitation unit, urinary retention was also found more frequent in patients with than without FI [28]. However, in this study, patients had rehabilitation for neurologic diseases (45%) or HF (25%). The anticholinergic load was calculated only for specific medications and was not fully adjusted on opioid dosage, for instance. Urinary retention was defined as 2 post-void residual volumes > 150 ml, which suggests that these patients were at least able to void. This threshold of 150 ml was questionable, especially in older adults in which a post-void residual volume could be more tolerated, with no greater risk of urinary infection [29]. Moreover, the authors reported that the urine volumes measured by the device used were significantly underestimated by a mean (SD) of 80.6 (111.3) ml [28]. Conversely, in our study, urinary retention was systematically assessed every 4 hr, so patients unable to void could also be included. Because of no consensual definition of POUR in older patients, we chose a 400-ml catheterization threshold, as is usually done in clinical practice [30].

Various hypotheses could explain this independent association between FI and POUR: mechanical bladder outlet obstruction [31], detrusor underactivity because of anal distension [32] and neurogenic bladder (i.e., neurologic pathology leading to both urinary and bowel

dysfunction). The bi-directional pelvic organ crosstalk concept could be the main explanation for the association between FI and POUR we found. Rectal distension alters bladder sensation (i.e., rectal distension lowers bladder sensation volume for each desire to void) [33]. Conversely, when the bladder is full, the sensation of rectal filling is decreased [34]. The anorectum and lower urinary tract share the same embryological structures, which explains why the same nerves are used for their peripheral innervations. Moreover, the central processing and integration of afferent activity converge to the same brain areas. In the pathophysiology, voiding function depends on the afferent pathways of C- and A-delta fibers, triggered by a mechanical distension of the bladder. Rapid colorectal distension increases the response in the afferent bladder pathways conducted by the C fibers only, which suggests that the convergence of bladder and colorectal peripheral nerves is conducted by mechanosensitive convergent C fibers [35]. Therefore, FI, more than simple constipation, induces rectal distension that leads to a mechanosensitive afferent message conducted by convergent C fibers that also increases the bladder afferent activity.

### ***Strengths and limitations***

To our knowledge, this is the first study to investigate the association between FI and POUR in a perioperative geriatric unit, offering early rehabilitation in addition to co-morbidities management, to patients. Potential confounding factors were considered in this analysis, such as age, sex, medications, and comorbidities, based on a direct acyclic graph. We also included a measurement of anticholinergic load, allowing for a detailed phenotyping of factors associated with POUR.

A few limitations should be considered. First, the cross-sectional design precludes us from drawing conclusions on the direction of the association between FI and POUR. However, if the pelvic organ crosstalk hypothesis is correct, this association could be bidirectional. Second,

selection biases were possible because of the monocentric patient inclusion. For instance, more than 90% of the study participants received opioids for post-operative pain, and we could not determine the opioid dosages, but unlike previous studies showing an association between POUR and opioids use [8], we did not find such an association. Similarly, we did not find an association between POUR and the time to recover the ability of walking, whereas Starer et al. suggested that immobility can explain both urinary retention and FI in an older population [18]. Nevertheless, these variables were included in our final model, and the association between FI and POUR was sustained.

Although comorbidities and their severity were included in the CIRS 52 score, we did not consider in detail potential confounders such as neurologic pathologies affecting bowel and bladder functions or pre-morbid voiding dysfunction, which could be high predictors of postoperative urinary retention.

Furthermore, POUR was not defined on real post-void catheterization volume. However, BladderScan is a non-invasive device, and both the International Continence Society [36] and French Health Authority [37] recommend the use of this device to measure post-void residual volume. This method of screening and definition of POUR could have led to a classification bias by overestimating the POUR rate. Nevertheless, this classification bias is non-differential, and non-differential misclassification of a dichotomous outcome will generally bias toward the null. [38]

Finally, only post-operative rate of FI was screened and recorded because patients arrived in UPOG after surgery. Because of the short time (in hours) to surgery after HF diagnosis, time to admission to the UPOG after HF diagnosis and time between surgery and admission to the UPOG (mean [SD] 37.5 [36.7], 73.3 [53.3], and 35.2 [55.7] hr, respectively), the pre-operative and post-operative FI rates were possibly nearly the same. Thus, potential factors affecting the

prevalence of preoperative FI (pain, comorbidities, anticholinergic load) was also considered in the multivariable analysis.

### **Conclusions**

In our study, older adults with POUR had more post-operative complications than those without POUR, which suggests more comorbidities, confirmed by higher CIRS 52 scores, longer in-hospital length of stay and higher rates of in-hospital death. Nevertheless, FI was the only independent factor associated with POUR after HF surgery. Further studies are needed to optimize perioperative geriatric care including FI and POUR management and to assess whether changes in practice can improve patient recovery.

**Conflict of interest.** None declared.

**Funding.** none.

### **Legends**

**Figure.** Flow of participants in the study.

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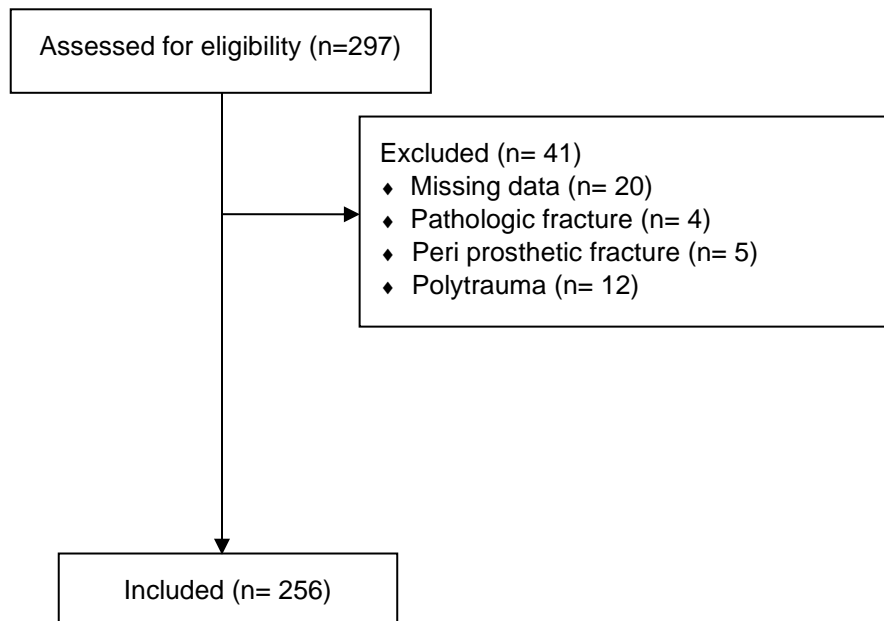
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**Figure 1.**



**Table 1.** Participants characteristics, overall and by presence of post-operative urinary retention (POUR).

	All participants (n=256)	No POUR (n=193)	POUR (n=63)	P value <sup>1</sup>
<b>Male</b>	61 (24%)	47 (24%)	14 (22%)	0.73
<b>Age, mean (SD)</b>	86 (6)	86 (6)	87 (7)	0.59
<b>Medical history</b>				
CIRS 52 score, mean (SD)	10 (4)	10 (4)	11 (4)	0.03
Dementia	104 (41%)	75 (39%)	29 (46%)	0.31
Depression	85 (33%)	65 (34%)	20 (32%)	0.77
Stroke	48 (19%)	34 (18%)	14 (22%)	0.41
Hypertension	173 (68%)	128 (66%)	45 (71%)	0.45
Diabetes mellitus	43 (17%)	30 (16%)	13 (21%)	0.35
Atrial fibrillation	69 (27%)	52 (27%)	17 (27%)	0.99
Coronary artery disease	47 (18%)	34 (18%)	13 (21%)	0.59
Chronic heart failure	42 (16%)	24 (12%)	18 (29%)	0.003
<b>Medications</b>				
Polypharmacy	237 (93%)	179 (93%)	58 (92%)	0.86
Opioids use	243 (95%)	182 (94%)	61 (97%)	0.74
Constipation treatment	240 (94%)	180 (93%)	60 (95%)	0.53
ARS score > 0	41 (16%)	33 (18%)	8 (13%)	0.55
<b>Autonomy</b>				
ADL score, median [Q1-Q3]	5.5 [3.5-6]	5.5 [3.5-6]	5 [3.5-6]	0.5
IADL score, median [Q1-Q3]	2 [0-4]	2 [1-4]	2 [0-4]	0.47
Living in nursing home	32 (13%)	26 (14%)	6 (10%)	0.41
Walking with assistance	164 (64%)	119 (62%)	45 (71%)	0.16
<b>Type of fracture</b>				
Intertrochanteric fracture	130 (51%)	91 (47%)	39 (62%)	0.05
Intracapsular hip fracture	126 (49%)	102 (53%)	24 (38%)	0.04
<b>Type of surgery</b>				
Partial hip replacement	113 (44%)	94 (49%)	19 (30%)	0.01
PFNA	129 (50%)	90 (47%)	39 (62%)	0.04
DHS	5 (2%)	3 (2%)	2 (3%)	0.59
Total hip replacement	5 (2%)	3 (2%)	2 (3%)	0.59
<b>General anesthesia</b>	254 (99%)	192 (99%)	62 (98%)	0.43
<b>In-hospital postoperative complications</b>				
Fecal impaction	108 (42%)	62 (32%)	46 (73%)	<0.001
Delirium	107 (42%)	75 (39%)	32 (51%)	0.09
Anemia	182 (71%)	138 (72%)	44 (70%)	0.8
Blood transfusion	68 (27%)	44 (23%)	24 (38%)	0.02
Pressure sore	27 (11%)	13(7%)	14 (22%)	<0.001
Atrial fibrillation	14 (5%)	12 (6%)	2 (3%)	0.5
Myocardial infarction	16 (6%)	9 (5%)	7 (11%)	0.06
Acute heart failure	24 (9%)	10 (5%)	14 (22%)	<0.001
Stroke	6 (2%)	3 (2%)	3 (5%)	0.16
Infection	22 (9%)	14 (7%)	8 (13%)	0.18
Venous thromboembolism	10 (4%)	6 (3%)	4 (6%)	0.27

Redo surgery	6 (2%)	4 (2%)	2 (3%)	0.64
ICU referral	14 (6%)	7 (4%)	7 (11%)	0.02
<b>In-hospital length of stay, days, mean (SD)</b>	10 (6)	10 (5)	12 (8)	0.01
<b>Time to recover walking ability, days, median [Q1-Q3]</b>	2 [1-3]	2 [1-3]	2 [1-4]	0.05
<b>In-hospital death</b>	6 (2%)	2 (1%)	4 (6%)	0.03

<sup>1</sup>Comparing the 2 groups by Student *t* test for quantitative variables and chi-square test or Fisher exact test for **categorical** variables.

ADL, **Activities** of Daily Living (normal range 0-6); ARS, anticholinergic risk scale; ARF, acute renal failure; APE, acute pulmonary edema; CIRS52, Cumulative Illness Rating Scale; DHS, dynamic hip screw; IADL, Instrumental Activities of Daily Living (normal range 0-4); ICU, intensive care unit; PFNA, Proximal Femoral Nail Antirotation; IQR, interquartile range; **Q1, 1<sup>st</sup> quartile; Q3, 3<sup>rd</sup> quartile**

**Table 2.** Factors associated with post-operative urinary retention in multivariable models.

	<b>Model 1</b> OR (95% CI)	<b>Model 2</b> OR (95% CI)	<b>Model 3</b> OR (95% CI)
<b>Discrete variables</b>			
<b>Sex</b>	0.98 (0.46-2.04)	0.83 (0.37-1.79)	0.75 (0.31-1.72)
Fecal impaction	5.76 (3.11-11.12)*	5.72 (3.02-11.32)*	4.78 (2.44-9.71)*
<b>Continuous variables</b>			
Age	1.02 (0.97- 1.07)	1.02 (0.97-1.07)	1.03 (0.98-1.09)
ARS score		0.88 (0.47-1.45)	0.74 (0.31-1.38)
CIRS 52 score		1.06 (0.97-1.15)	1.06 (0.97-1.17)
Time to recover walking ability			1.11 (0.97-1.26)

\* $P < .001$

OR, odds ratio; 95% CI, 95% confidence interval; CIRS 52, Cumulative Illness Rating Scale; ARS, Anticholinergic Risk Scale