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Original Article

Enhanced recovery urinary protocol for patients undergoing hip surgery: a quasi-experimental study

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Abstract

Introduction: Postoperative urinary retention (POUR) is a common complication after hip surgery. The enhanced recovery urinary protocol (ERUP) is a tool that employs several perioperative strategies to facilitate optimal conditions for surgery and recovery. The aim of this study was to evaluate the effect of ERUP on POUR in patients undergoing hip surgery.

Methodology: A controlled pre- and post-quasi-experimental study was conducted. Data was collected between May 2018 and January 2019 at the orthopedic department of one of the largest teaching hospitals affiliated with Menoufia University in Egypt. A convenience sample of 100 Egyptian patients (of both genders) undergoing elective hip surgery was equally allocated into two groups. The control group (n = 50) was given traditional routine perioperative nursing care, while the intervention group (n = 50) was subjected to ERUP. Data was collected from socio-demographic, medical, and surgical data sheets, preoperative medication assessment sheets, postoperative data sheets, and fluid balance charts.

Results: ERUP application significantly reduced the length of hospital stay and the incidence of POUR in the intervention group.

Conclusions: Implementation of the ERUP is recommended for patients undergoing hip surgery, as it has a significantly positive effect on reducing the incidence of POUR.

Key words: enhanced recovery urinary protocol; hip surgery; postoperative urinary retention; nursing care.

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Introduction

A hip fracture is a life-changing event for any patient as the risks of disability, increased dependence, and death are significant [1]. Each year, hip fractures result in loss of at least 2.35 million disability-adjusted life years, and more than 5 million people worldwide experience disability from a hip fracture. Hip surgery can be of different types, such as total hip replacement, partial hip replacement, and hip resurfacing [2]. The number of cases involving hip surgery has significantly increased due to the fast-growing aging population worldwide, with approximately 0.33 million total hip arthroplasties (THA) performed annually in the United States [3].

The American Medical Association defines urinary retention (UR) as the most frequent complication observed between the 2nd and 4th hour after surgery. Postoperative urinary retention (POUR) is the inability to pass urine following surgery and is characterized by a painful, palpable bladder [4]. It is a relatively common complication among patients with hip surgery, with an incidence rate of up to 82% preoperatively [5,6]. The incidence of POUR ranges between 5% and 70%, depending on the type of surgery [4]. It can lead to delayed hospital discharges, increased financial costs, and reduced quality of life [5,6].

The enhanced recovery urinary protocol (ERUP) applies a clinical pathway for a surgical procedure, beginning in primary care, using several perioperative strategies to facilitate optimal conditions for surgery and recovery [7,8]. ERUP continues throughout the perioperative period, including post-discharge planning, and return to normal activities [9]. ERUP includes several components, such as avoiding prolonged fasting, preoperative optimization of carbohydrate loading, patient blood management, goal-

directed hemodynamic therapy, multimodal analgesia with opioid avoidance, and early withdrawal of the urinary catheter. The specific components of the protocol include preoperative preparation (through education, breathing, and coughing exercises), bladder training and voiding, and discharge planning [3].

The ERUP protocol requires an evidence-based, interdisciplinary, patient-centered approach to reduce patients' responses to surgical stress, optimize their physiological functions, and facilitate surgical recovery. Previous studies have demonstrated that the ERUP protocol can decrease hospital stays by 2–3 days and decrease morbidity and complication rates by 30–50%, thus reducing healthcare costs for both the hospital and the patient [10].

Despite the growing incidence of UR among patients undergoing hip surgery, ERUP has not been evaluated among these patients in Egypt. This study aimed to investigate the effect of ERUP on the incidence of POUR among patients undergoing hip surgeries.

Methodology

Study design

A control, pre-, and post-quasi-experimental study was conducted between May 2018 and January 2019 using a convenience sample of Egyptian patients undergoing elective hip surgery. The inclusion criteria were patients older than 18 years, able to communicate, prepared for spinal anesthesia, with no history of urinary tract disorders, including known prostatic pathology or urinary tract infection one week prior to surgery, no connection to urinary catheterization in the pre-operative period, and no previous history of any urinary tract surgery or previous POUR.

Study setting and sample size calculation

The study was conducted at the orthopedic department of one of the biggest teaching hospitals affiliated with Menoufia University in Egypt. The required sample size was calculated using the Open EPI calculator [11]. This was based on a 95% confidence interval, a 5% margin of error, and a prevalence of UR of 30% as reported by a previous study [12]. The minimum estimated sample size was 86 (43 for each group), which was adjusted to 100 to compensate for the non-response rate.

Study tools and data collection

One hundred patients who underwent elective hip surgery agreed to participate in this study and signed informed consent forms. They were randomly allocated to control and intervention groups, each consisting of 50 patients. The control group received standardized perioperative care from the hospital nursing staff without any intervention from the researchers. The intervention group received education on ERUP from the researchers. The researchers were available during morning and afternoon shifts four days a week throughout the study period.

After explaining the aim of the study to each patient, study tools were used to collect data. The investigators developed these tools based on recent literature [13–16] and divided them into five sections. The first four sections were applied to all patients, while the last section was performed only on the intervention group. The five sections were as follows:

1. Sociodemographic, medical, and surgical data sheets included age, gender, level of education, medical history, weight, height, smoking habit, medical diagnosis, presence of co-morbidities, date of admission, history of any previous surgeries, type of recommended surgery, the date of the operation, length of the operation, and fluid administered during the operation.
2. The preoperative medication assessment sheet included anticholinergics, antiarrhythmics, opioids, and antidepressants.
3. The postoperative data sheet assessed UR, including the timing of urinary catheter removal, the timing and amount of first spontaneous voiding after urinary catheter removal, the occurrence of UR, and its severity. A retention scale was used to determine UR grades as follows: 1 = mild UR, 2 = moderate retention, and 3 = severe retention. In this scale, 1 = mild hesitancy, where non-invasive measures (such as alternative toileting methods, placing a hot-water bottle on the hypogastrium, and turning on taps) were used; 2 = requirement of a straight catheter; and 3 = Requirement of a Foley catheter.
4. The fluid balance chart, which measures intake and output during the perioperative period (two days prior to the operation, intraoperatively, and two days postoperatively) was also reviewed.
5. The standardized tool, ERUP, was applied to the intervention group only through three consecutive steps: A) preoperative preparation, which included preoperative education, limitation of fluid administered as indicated by the surgeon, breathing and coughing exercises, and education about the importance of spontaneous voiding before going to the operating room; B) bladder training and voiding, which included training for positioning in

bed during voiding, preparation of equipment to facilitate voiding, voiding in a urinal to measure urine output, perineal care, bladder training to strengthen ureteral muscles, and the importance of early mobilization and spontaneous voiding after the operation; and C) discharge plan, which included instructions for after surgery and at-home care, such as the importance of early ambulation, low use of systematic opioids, and non-invasive alternative methods of managing POUR, such as hot packs on the suprapubic area.

A pilot study was performed on ten patients to evaluate the clarity and applicability of the developed tools and the estimated completion time. The results of the pilot study were excluded from the main study, and necessary modifications were made accordingly. A panel of five experts in the medical-surgical, nursing, and medical fields reviewed the face and content validity of the study tools. The study tools were validated by a Cronbach's alpha coefficient of 0.79, indicating acceptable internal consistency.

Ethical considerations

The Ethical Committee of Scientific Research Review, Faculty of Nursing, Menoufia University, Egypt, approved this study on 15 April 2018 (reference No. 533/2018). Anonymity and confidentiality of the participants was maintained. Informed consent was obtained from each participant prior to the start of the study.

Data analysis

The data were analyzed using Statistical Package for the Social Sciences (SPSS) for Windows, version 25.0 (Released 2017. IBM Corp. Armonk, NY). Quantitative data were presented as mean and standard deviation (mean ± SD). Student t-test and Mann–Whitney tests were applied to compare two groups of normally and non-normally distributed variables, respectively. Qualitative data were expressed in numbers and percentages (no and %), and the Chi-square (χ^2) test was used. Fisher's exact test was used if any expected qualitative data was less than 5. Differences were considered significant at p value < 0.05.

Table 1. Comparison of socio-demographic, medical, and surgical data of intervention and control groups.

Variable	Study groups		*p* value
	Interventional protocol no (%)	Control no (%)	
A. Socio-demographic data			
Gender:			
Male	31 (53.4)	27 (46.6)	
Female	19 (45.2)	23 (54.8)	0.417[#]
Age in years (mean ± SD)	49.68 ± 7.18	50.34 ± 7.71	0.656[a]
Marital status			
Single	11 (45.8)	13 (54.2)	
Married	30 (56.6)	23 (43.4)	0.453[#]
Widow	7 (43.8)	9 (56.3)	
Divorced	2 (28.6)	5 (71.4)	
Education level			
Illiterate	14 (70)	6 (30)	
Primary	15 (48.4)	16 (51.6)	0.227[#]
Secondary	11 (40.7)	16 (59.3)	
High	10 (45.5)	12 (54.5)	
BMI (mean ± SD)	24.85 ± 1.97	23.90 ± 3.86	0.124[a]
Smoking habit			
Yes	18 (51.4)	17 (48.6)	0.833[#]
B. Medical data			
Previous surgery			
Yes	8 (34.8)	15 (65.2)	0.096[#]
Medical diagnosis			
Osteoarthritis	10 (38.5)	16 (61.5)	
Fracture	33 (55)	27 (45)	0.370[#]
Others	7 (50)	7 (50)	
Presence of comorbidities			
Yes	39 (55.7)	31 (44.3)	0.080[#]
C. Surgical data			
Length of hospital stay in days (mean ± SD)	6.30 ± 1.87	10.34 ± 3.33	< 0.001[a]**
The type of surgery			
Total hip replacement	42 (52.5)	38 (47.5)	
Hemiarthroplasty	6 (40)	9 (60)	0.606[#]
Hip repair	2 (40)	3 (60)	
Length of procedure in hours (mean ± SD)	1.32 ± 0.33	1.40 ± 0.43	0.313[a]

[#]: χ^2 test; [a]: Student *t*-test; **: highly significant; BMI: body mass index.

Results

Socio-demographical characteristics, medical, and surgical data

There was an insignificant difference in socio-demographic characteristics such as gender, age in years, marital status, education level, body mass index (BMI), and smoking habit, between the patients who received ERUP (intervention group) and the control group ($p > 0.05$). Additionally, the intervention group and controls had similar medical and surgical data, without significant differences, including previous surgery, medical diagnosis, and other comorbidities ($p > 0.05$). Moreover, there was an insignificant difference between intervention group patients and controls regarding the type of operation and the procedure length in hours ($p > 0.05$). However, the mean number of hospital stay days was significantly lower among cases in the intervention group (6.3 ± 1.87 days) than among controls (10.34 ± 3.33 days; $p < 0.001$) (Table 1).

Post-operative data

The incidence of UR among the intervention group patients (34.5%) was significantly lower than among the control group (65.5%, $p = 0.04$). The patients in the intervention group had a significantly shorter first postoperative spontaneous voiding time (hours) after removal of the catheter (2.28 ± 1.76 hour) and a lower amount of urine recorded in the first spontaneous voiding (334.8 ± 161.9 mL) than controls (4.46 ± 2.87 hour and 426.8 ± 204.6 mL, respectively) ($p < 0.001$ for both). It was evident that the protocol was significantly effective in reducing the need for re-catheterization, as only one patient needed re-catheterization in the intervention group (5%) compared to 19 patients in the control group (95%) ($p < 0.001$). The number of cases with severe UR was significantly lower in the intervention group (only two patients, 13%) than in the control group (13 patients, 87%) ($p = 0.003$) (Table 2).

Fluid parameters of the studied groups

Among the patients subjected to ERUP (intervention group), the mean values of preoperative days 1 and 2 intakes (1752.50 ± 183.43 mL/day and 1394.00 ± 168.31 mL/day, respectively), preoperative days 1 and 2 urine outputs (979.0 ± 125.39 mL/day and 818.0 ± 89.65 mL/day, respectively), and intraoperative intravenous fluid (818.0 ± 127.28 mL) did not statistically differ from the control group (1708.00 ± 209.8 mL, 1376.00 ± 147.86 mL, 968.0 ± 107.74 mL, 830 ± 97.42 mL, and 844.00 ± 128.39 mL, respectively) ($p > 0.05$). A significantly lower mean value of preoperative post-void residual was observed among the cases in the intervention group (57.14 ± 54.45 mL) than in the control group (104.78 ± 66.04 mL) ($p < 0.001$).

Regarding postoperative fluid parameters, the mean values of postoperative days 1 and 2 intakes were significantly higher among the ERUP intervention group (1324 ± 133.34 mL/day and 1476.00 ± 142.23 mL/day, respectively) than in the control group (1248.0 ± 170.52 mL/day and 1204.00 ± 130.87 mL/day, respectively) ($p = 0.01$ and < 0.001, respectively). Moreover, cases who received the protocol had a significantly higher mean value of postoperative days 1 and 2 urine outputs (867.0 ± 147.64 mL/day and 472.0 ± 92.12 mL/day, respectively) than the control group (792.00 ± 112.19 mL/day and 418.00 ± 121.96 mL/day, respectively) ($p = 0.005$ and 0.01, respectively). The intervention group cases showed a lower mean value of postoperative post-void residual (143.36 ± 165.49 mL) than the control group (241.98 ± 237.32 mL), although this was not statistically significant ($p > 0.05$) (Table 3).

Table 2. Comparison of post-operative data in intervention and control groups.

Post-operative data	Study groups		*p* value
	Interventional Protocol No (%)	Control No (%)	
Incidence of post-operative urinary retention:			
Absent	40 (56.3)	31 (43.6)	0.047#*
Present	10 (34.5)	19 (65.5)	
Time of the first postoperative spontaneous voiding after removal of catheter (in hours) (mean ± SD)	2.28 ± 1.76	4.46 ± 2.87	< 0.001b**
Amount of urine (in mL) recorded in the first spontaneous voiding (mean ± SD)	334.80 ± 161.90	426.80 ± 204.60	< 0.001b**
Effect of protocol on re-catheterization (among patients with UR)			
No need	9 (100)	0 (0.0)	< 0.001#**
Required	1 (5)	19 (95)	
UR graded:			
None	40 (56.3)	31 (43.6)	0.003#*
Mild	4 (100)	0 (0.0)	
Moderate	4 (40)	6 (60)	
Severe	2 (13.3)	13 (86.7)	

#: χ^2 test; b: Mann–Whitney U test; *: significant; **: highly significant; UR: urinary retention.

Table 3. Comparison of fluid parameters in the intervention and control groups.

Fluid parameter (mean ± SD)	Studied group		
	Interventional protocol	Controls	*p* value
Preoperative day 1 intake (mL/day)	1752.50 ± 183.43	1708.00 ± 209.80	0.263[a]
Preoperative day 1 urine output (mL/day)	979.00 ± 125.39	968.00 ± 107.74	0.641[a]
Preoperative day 2 intake (mL/day)	1394.00 ± 168.31	1376.00 ± 147.86	0.568[a]
Preoperative day 2 urine output (mL/day)	818.00 ± 89.65	830.00 ± 97.42	0.516
Preoperative post-void residual volume (mL)	57.14 ± 54.45	104.78 ± 66.04	< 0.001[b**]
Intraoperative intravenous fluid (mL)	818.00 ± 127.28	844.00 ± 128.39	0.302[a]
Intraoperative urine output (mL)	418.00 ± 121.96	472.00 ± 92.12	0.014[a*]
Postoperative day 1 intake (mL/day)	1324.00 ± 133.34	1248.00 ± 170.52	0.012[a*]
Postoperative day 1 urine output (mL/day)	867.00 ± 147.64	792.00 ± 112.19	0.005[a*]
Postoperative day 2 intake (mL/day)	1476.00 ± 142.23	1204.00 ± 130.87	< 0.001[a*]
Postoperative day 2 urine output (mL/day)	472.00 ± 92.12	418.00 ± 121.96	0.014[a*]
Postoperative post-void residual volume (mL)	143.36 ± 165.49	241.98 ± 237.32	0.133[b]

[a]: Student t-test; [b]: Mann–Whitney U test; [*]: significant; [**]: highly significant.

Relationship between sociodemographic, medical, and surgical data; and post-void residuals and UR

UR was significantly more prevalent among male subjects in the control group (55.5%) than in the intervention group (45.5%) (p = 0.03). No females experienced UR in the latter group. Patients with UR in the control group stayed in the hospital for a significantly longer duration (12.74 ± 2.81 days) than their counterparts in the intervention group (8.30 ± 3.02 days) (p = 0.001). Other socio-demographic criteria such as age in years, marital status, education level, BMI, and smoking habits showed an insignificant association with UR between both groups ($p > 0.05$). Medical and surgical data, such as the presence of comorbidities, previous surgeries, medical diagnosis, type of surgery, and length of the procedure in hours, did not differ significantly according to UR grades between the studied groups ($p > 0.05$).

Upon comparing preoperative and postoperative post-void residuals between patients who had UR in the

Table 4. Comparison of sociodemographic, medical, and surgical data, and post-void residuals in patients who had urinary retention (UR) in both groups.

Variable	Study groups		*p* value
	Interventional protocol with UR (No. = 10)	Controls with UR (No. = 19)	
Gender			
Male	10 (45.5)	12 (54.5)	0.027[#*]
Female	0 (0.0)	7 (100)	
Age in years (mean ± SD)	51.00 ± 8.73	55.37 ± 8.71	0.204[a]
Marital status			
Married	7 (38.9)	11 (61.1)	0.691[c]
Single	3 (27.3)	8 (72.7)	
Education level			
Basic and below	6 (33.3)	12 (66.7)	0.587[c]
Secondary and above	4 (36.4)	7 (63.6)	
BMI (mean ± SD)	24.73 ± 1.80	22.86 ± 5.29	0.290[a]
Smoking			
Smoker	4 (44.4)	5 (55.6)	0.568[c]
Non-smoker	6 (30)	14 (70)	
Previous surgeries			
Yes	4 (8.3)	12 (91.7)	0.233[#]
No	6 (52.9)	7 (47.1)	
Medical diagnosis			
Osteoarthritis	3 (27.3)	8 (72.7)	
Fracture	6 (37.5)	10 (62.5)	0.766[#]
Others	1 (50)	1 (50)	
Comorbidity			
Present	8 (38.1)	13 (61.9)	0.676[c]
Absent	2 (25)	6 (75)	
Length of hospital stay in days (mean ± SD)	8.30 ± 3.02	12.74 ± 2.81	< 0.001[b**]
Type of surgery			
Total hip replacement	7 (33.3)	14 (66.7)	
Hemiarthroplasty	1 (25)	3 (75)	0.741[#]
Hip repair	2 (50)	2 (50)	
Length of procedure in hours (mean ± SD)	1.63 ± 0.51	1.62 ± 0.45	0.957[a]
Preoperative post-void residual (mean ± SD)	132.20 ± 72.16	167.32 ± 60.33	0.102[b]
Postoperative post-void residual (mean ± SD)	419.90 ± 181.55	523.95 ± 128.48	0.137[b]

[#]: χ^2 test; [a]: Student t-test; [b]: Mann–Whitney U test; [c]: Fisher's exact test; [*]: significant; [**]: highly significant.

studied groups, it was clear that cases that were subjected to ERUP had lower mean values of both (132.2 ± 72.16 mL and 419.90 ± 181.55 mL, respectively) than the control group (167.32 ± 60.33 mL and 523.95 ± 128.48 mL, respectively), although this was not statistically significant ($p > 0.05$) (Table 4).

Discussion

The present study demonstrated that the incidence of UR among patients undergoing hip surgery was significantly reduced by applying ERUP. The interventional protocol group had a much lower incidence of UR (20%) than the control group (38%). Moreover, the study found that only a small proportion of patients subjected to ERUP (4%) developed severe POUR compared to the control group, where 26% developed severe UR. This finding highlights the significance of bladder training exercises that can strengthen the bladder muscles, enhance voiding, and decrease UR incidence.

Several studies have previously reported similar findings. For instance, Ripollés-Melchor *et al*. found that applying ERUP for total hip and knee arthroplasty was associated with improved postoperative outcomes and reduced postoperative complications, especially UR, compared with routine nursing care in Spain [17]. Similarly, a recent study in France among patients with elective orthopedic surgery reported that postoperative morbidity, including UR, and mortality declined after implementing ERUP [18].

Furthermore, the study found that male patients were more (2-3 times more) likely to experience POUR than female patients. The incidence of UR was significantly higher among male patients in both the intervention and control groups. This finding is consistent with previous studies that have reported a higher incidence of POUR among male patients [15,19,20].

Additionally, our study indicated that the length of hospital stay was significantly lower among patients in the interventional protocol group compared to the control group. This reduction in the duration of a hospital stay has financial benefits for both patients and the hospital, and minimizes the risk of infection. Similar findings have been reported in other studies, including those by Melchor *et al*. and Liu *et al*., who found that patients receiving ERUP had shorter hospital stays than those in the control group [17,21]. Moreover, Venditoli *et al*. observed a reduced hospital stay of 2.8 days when performing ERUP for patients undergoing total hip arthroplasty [22]. In Greece, a similar finding was reported in reducing hospital stay days with no increase in mortality, complications, or re-admission after implementing ERUP among oncology patients undergoing hip or knee reconstruction surgery [23].

This study demonstrated that patients in the intervention group had significantly lower preoperative and postoperative post-void residual volumes than the control group, indicating improved bladder emptying due to ERUP. A comparison between the intervention group patients who developed POUR and those who had POUR after receiving traditional nursing care revealed that mean preoperative and postoperative post-void residual volumes were lower in the former group. However, the difference was not statistically significant. This result is consistent with previous findings by Valsalan and Chandran [24], who reported that increasing preoperative post-void residual volume triples the likelihood of developing POUR within 3–4 years of follow-up. Furthermore, a recent study in New York demonstrated an increased risk of catheterization and POUR associated with higher post-void residual volumes and an independent association between postoperative bladder volume greater than 270 mL and the development of POUR [25].

Regarding the need for re-catheterization among patients who developed UR, only one out of ten patients (10%) in the intervention group required re-catheterization, while all 19 cases in the control group needed re-catheterization. These findings underscore the effectiveness of ERUP in reducing urinary catheter duration, promoting early ambulation, and decreasing the risk of catheter-associated urinary tract infections. These results are consistent with previous studies by Liu *et al*. and Magaldi *et al*. [21,26].

Additionally, the study found that intraoperative urine output, which reflects intraoperative intravenous (IV) fluid intake, was significantly lower in the intervention group than in the control group. This finding is supported by the hypothesis put forward by Keita *et al.* [25] that excessive fluid administration during surgery inhibits the normal micturition reflex, leading to bladder over-distension and increased risk of POUR.

Conclusions

Implementing an enhanced urinary recovery protocol for hip surgery patients is beneficial. This protocol significantly reduced the incidence of POUR, the length of hospital stay, and the need for re-catheterization.

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Authors' contributions
ASB: conceived and designed the study, curated data, and revised the manuscript; MAB, EAA, and EHA: contributed to the study design, data curation, and writing and revision of the manuscript. All the authors have read and approved the final version.

Data availability statement
The data presented in this study are available upon request from the corresponding author.

References
1. Ismail MSA, Khaled AS, El-Nahal, A, El-Geady I (2017) Short-term (2 years) results of primary total hip replacement in 40 mobile elderly patients with fractured neck of femur. Egypt Orthop J 52: 175-179. doi: 10.4103/eoj.eoj_49_17.
2. Yang Q, Li J, Shi D, Xie H, Wang J, Shi Z, Zhang Y (2022) Incidence and risk factors associated with hospital-acquired pressure ulcers following total hip arthroplasty: a retrospective nationwide inpatient sample database study. J Tissue Viability 31: 332-338. doi: 10.1016/j.jtv.2022.01.004.
3. Yin M, Yan Y, Fan Z, Fang N, Wan H, Mo W, Wu X (2020) The efficacy of enhanced recovery after surgery (ERAS) for elderly patients with intertrochanteric fractures who received surgery: study protocol for a randomized, blinded, controlled trial. J Orthop Surg Res 15: 1-9. doi: 10.1186/s13018-020-01586-w.
4. Kwak DK, Oh CY, Lim JS, Lee HM, Yoo JH (2019) Would early removal of indwelling catheter effectively prevent urinary retention after hip fracture surgery in elderly patients? J Orthop Surg Res 14: 1-8. doi: 10.1186/s13018-019-1360-1.
5. Kremers H, Larson D, Crowson C, Kremers W (2015) Prevalence of total hip and knee replacement in the United States. J Bone Joint Surg 97: 1386-1397. doi: 10.2106/JBJS.N.01141.
6. Proliance Orthopedic (2021) The results of the American joint replacement registry 2020. Available: https://www.prolianceorthopedicassociates.com/dr-barrett-blog/the-results-of-the-2020-american-joint-replacement-registry. Accessed: 12 August 2021.
7. Macones GA, Caughey AB, Wood SL, Wrench IJ, Huang J, Norman M, Pettersson K, Fawcett WJ, Shalabi MM, Metcalfe A, Gramlich L, Nelson G, Wilson RD (2019) Guidelines for postoperative care in cesarean delivery: enhanced recovery after surgery (ERAS) Society recommendations (part 3). AJOG 221: 247-249. doi: 10.1016/j.ajog.2019.04.012.
8. Agrawal K, Majhi S, Garg R (2019) Post-operative urinary retention: review of literature. World J Anesthesiol 8: 1-12. doi: 10.5313/wja.v8.i1.1.
9. Lee KS, Koo KC, Chung BH (2017) Risk and management of postoperative urinary retention following spinal surgery. INJ 21: 320-328. doi: 10.5213/inj.1734994.497.
10. Ongün P, Ak SE (2020) Examination of knowledge levels of nurses working in surgical clinics about ERAS protocol. Med J Bakirkoy 16: 287-294. doi: 10.5222/BMJ.2020.81300.
11. OpenEpi (2006) Open source epidemiologic statistics for public health. Available: https://www.openepi.com/Menu/OE_Menu.htm. Accessed: 28 May 2021.
12. Kotwal R, Hodgson P, Carpenter C (2008) Urinary retention following lower limb arthroplasty: analysis of predictive factors and review of literature. Acta Orthop Belg 74: 332-336.
13. Afazel MR, Jalali E, Sadat Z, Mahmoodi H (2014) Comparing the effects of hot pack and lukewarm-water-soaked gauze on postoperative urinary retention; a randomized controlled clinical trial. Nurs Midwifery Stud 3: e24606. doi: 10.17795/nmsjournal24606.
14. Simsek ZY, Karaoz S (2017) Effect of nursing interventions on prevention and management of postoperative urinary retention for patients with orthopedic surgery under spinal anaesthesia. Int. J. Caring Sci 10: 522-531.
15. Balderi T, Mistraletti G, D'angelo E, Carli F (2011) Incidence of postoperative urinary retention (POUR) after joint arthroplasty and management using ultrasound-guided bladder catheterization. Minerva Anestesiol 77: 1050-1057.
16. Okrainec A, Aarts MA, Conn LG, McCluskey S, McKenzie M, Pearsall EA, Rotstein O, Victor JC, McLeod RS, members of the iERAS Group (2017) Compliance with urinary catheter removal guidelines leads to improved outcome in enhanced recovery after surgery patients. J Gastrointest Surg 21: 1309-1317. doi: 10.1007/s11605-017-3434-x.
17. Ripollés-Melchor J, Abad-Motos A, Logroño-Egea M, Aldecoa C, García-Erce JA, Jiménez-López I, Cassinello-Ogea C, Marín-Peña O, Ferrando-Ortolá, C, de la Rica AS, Gómez-Ríos MA, Sánchez-Martín R, Abad-Gurumeta A, Casans-Francés R, Mugarra-Llopis A, Varela-Durán M, Longás-Valién J, Ramiro-Ruiz Á, Cuellar-Martínez AB, Calvo-Vecino JM (2019) Postoperative outcomes within enhanced recovery after surgery protocol in elective total hip and knee arthroplasty. POWER.2 study: study protocol for a prospective, multicentre, observational cohort study. Turk J Anaesthesiol Reanim 47: 179-186. doi: 10.5152/TJAR.2019.87523.
18. Slim K, Theissen A (2020) Enhanced recovery after elective surgery. A revolution that reduces post-operative morbidity and mortality. J Visc Surg 157: 487-491. doi: 10.1016/j.jviscsurg.2020.07.005.
19. Balderi T, Carli F (2010) Urinary retention after total hip and knee arthroplasty. Minerva Anestesiol 76: 120-130.
20. Ziemba-Davis M, Nielson M, Kraus K, Duncan N, Nayyar N, Meneghini RM (2019) Identifiable risk factors to minimize postoperative urinary retention in modern outpatient rapid recovery total joint arthroplasty. J Arthroplasty 34: S343-S347. doi: 10.1016/j.arth.2019.03.015.
21. Liu Y, Fu M, Zhou Q, Tian M, Zhang X, Wang Z (2022) The application of patient-centered care bundle significantly reduces incidence of perioperative respiratory complications in hip fracture patients aged 80 and over. Geriatr Nurs 43: 213-228. doi: 10.1016/j.gerinurse.2021.11.014.
22. Vendittol PA, Pellei K, Desmeules F, Massé V, Loubert C, Lavigne M, Fafard J, Fortier LP (2019) Enhanced recovery short-stay hip and knee joint replacement program improves patient's outcomes while reducing hospital costs. OTSR 105: 1237-1243. doi: 10.1016/j.otsr.2019.08.013.
23. Bourazani M, Asimakopoulou E, Magklari C, Fyrfiris N, Tsirikas I, Diakoumis G, Kelesi M, Fasoi G, Kormas T, Lefaki G (2021) Developing an enhanced recovery after surgery program for oncology patients who undergo hip or knee

reconstruction surgery. WJO 12: 346-359. doi: 10.5312/wjo.v12.i6.346.
24. Valsalan VK, Chandran S (2017) Comparative study of urinary retention in lower limb surgeries between general and spinal anesthesia. Int J Sci Study. 5: 134-147.
25. Keita H, Diouf E, Tubach F, Brouwer T, Dahmani S, Mantz J, Desmonts JM (2005) Predictive factors of early postoperative urinary retention in the postanesthesia care unit. Anesth Analg 101: 592-606. doi: 10.1213/01.ANE.0000159165.90094.40.
26. Magaldi RJ, Strecker SE, Nissen CW, Carangelo RJ, Grady-Benson J (2022) Preoperative factors to assess risk for postoperative urinary retention in total joint arthroplasty: a retrospective analysis. Arthroplast Today. 13: 181-187. doi: 10.1016/j.artd.2021.10.009.

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