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URINARY RETENTION FOLLOWING ROUTINE NEUROSURGICAL SPINE PROCEDURE

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Abstract:

Background: *Postoperative urinary retention (POUR) is a frequent disorder in adult neurosurgical patients. It can lead to urogenital damage, prolonged hospital stay, higher cost, and infection. This study examines several risk factors that contribute to POUR in a number of neurosurgical patients.*

Methods: *A 137 neurosurgical patients were selected for study. Patients were followed up for the development of POUR, initial post void residual (PVR1) >250 ml 6 hours after removal of an indwelling urinary catheter (IUC) were used as the established protocol criteria. \IUCs were reinserted and kept in for 5-7 days, for patients with PVR >250 ml on the third check*

Results: *Total 137 patients were recruited for the study 68 (50%) were male, 41% (56/137) were 60 years or older, 86% (118/137) underwent spinal surgery, and 54% (74/137) had anesthesia over 200 minutes. Incidence of POUR was 39.4% (54/137). Significantly higher rates of PVR1 >250 were find out in males, patients who had age more than 60 years, and those who experienced spine surgery, only gender, surgery time, and surgery type remained significant when considering all the characteristics of patients. Moreover, PVR1 >250 was positively associated with longer length of stay. The association of IUC reinsertion with male gender was significant.*

Conclusion: *Males, duration of anesthesia >200 minutes, increase in age, and spinal surgery are the most important risk factors associated with POUR in neurosurgical patients.*

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INTRODUCTION:

Postoperative urinary retention (POUR) is a common problem across many surgical specialties. [1] Some may considered it as a minor complication; however, it can move to significant pain, anxiety, and cost, as well as prolonged hospital stay for many patients. [2,3] In the elderly population POUR and its standard treatment by straight catheterization can lead to urethral strictures, trauma, infection, and possibly delirium. [4] It has been reported that a single significant episode of bladder distention can lead to the weakening of bladder collagen fibers resulting in chronic impairment of bladder emptying capacity or even atony. [1,4] Permanent damage of the detrusor muscle can significantly contribute to long-term morbidity. Reported rates range from 5% to 75%. [5,6] although lumbar degenerative diseases are the most common indications for spine surgeries, the risk of POUR in these cases has not been highlighted, and only a few studies have investigated the incidence of and risk factors for POUR in these patients. [7,8]

Nationwide health quality improvement efforts are currently underway to address complications such as deep venous thrombosis (DVT) or urinary tract infections (UTIs). Although POUR is not identified among such complications, it is a potential source of UTI and bacteremia. [1,4,9]

Some orthopedic procedures are known to carry a higher risk of POUR i.e . Urologic, colorectal, and certain [4] The lots of incidence rated is documented in different studies that is related to factors that include differences in patient characteristics, lack of a standard definition, and conflicting clinical trials. [4] A few risk factors such as old age, male gender, and preexisting urologic symptoms have been associated with development of POUR in some studies. [1,10] Other risk factors such as net balance of intraoperative intravenous fluid (NBIOIVF), length and type of anesthesia, body mass index (BMI), preexisting diabetes mellitus (DM), as well as the amount, type, and mode of delivery of postoperative pain medication may have a role in the development of POUR. [1,4,9] Certain medications, such as beta blockers and anticholinergic agents, are also thought to play a role in the development of POUR. [10,11]

Patients has not been studied extensively for the risk of POUR in neurosurgical surgeries. Boulis *et al*.[3] stated a 39.1% incidence in 503 spine patients. In other studies reported incidence is 23% and 22.9%, respectively, in their lumbar spine patients who had experienced general anesthesia. Neurosurgical pathologies, includes both types of the nervous system whether it is central and peripheral nervous systems, add complexity to the etiology of POUR. In this study the aim to elucidate some of the risk factors that plays role to the incidence of POUR in different neurosurgical patients.

METHOD:

Postoperative voiding care protocol, which was established by the Department of Urology has been applied for all patients undergoing spinal surgery under general anesthesia (Fig. 1). Patients who underwent spine surgery with an intraoperative indwelling urinary catheter under general anesthesia were selected. POUR, per hospital protocol, was defined as an initial post void residual (PVR1) greater than 250 ml using bladder ultrasonography (BVI 3000, Verathon) indwelling urinary catheters (IUCs) that were inserted during the time of surgery was removed after 6 hours. Straight catheterization was done for patients with any PVR greater than 250 ml every 6 hours. IUCs were reinserted for patients with the third PVR greater than 250 ml, 5-7 days for follow-up to the urology clinic were recommended to patients who were discharged. Subsequently, records of the patients were reviewed to identify the characteristics of the patient such as age, sexes, Body mass index, duration of anesthesia, type of surgery (cervical, thoracic, lumbar, and cranial), diagnosis of DM before operation, usage of selective alpha blockers, beta blockers, anticholinergic agents, T2 signal on cervical, and thoracic magnetic resonance imaging (MRI), NBIOIVF, and duration of hospital stay. Two patients who underwent thoraco-lumbar surgeries out of 137 were included in the thoracic group. Due to the small sample of thoracic patients, cervical and thoracic patients are grouped as combined into the cervico-thoracic group.

ANALYSIS:

To assess the associations between PVR1 and demographic, medical, and surgical information nonparametric methods were used such as Wilcoxon two sample tests, Kruskal–Wallis test, and Spearman's correlation coefficients. Due to wide distribution of values for PVR1 which ranged from 0 to 1000 non parametric method is used instead of parametric. Regression methods was used to find out that which variable is clearly associated with PVR1 by using stepwise procedures, males only and females only. Chi-square tests were done to assess the relationship between patient characteristics and IUCs for the categorical variables and Wilcoxon nonparametric two sample tests for the continuous variables (PVR1 and NBIOIVF). In addition, sensitivity, specificity, and positive and negative predictive values for IUC reinsertion based on specific cut points of PVR1 were computed. The

testing alpha level was set at 0.05. All statistical analyses were done using SAS (Cary, NC, USA) version 9.2.

RESULTS:

Total 137 patients were selected, out of them 68 (50%) were male and the mean age was 57.5 years (SD = 14, range 26-95 years). The remainder of the patient characteristics is shown in Table 1. 54/137 patients had POUR based on our criteria of PVR1 greater than 250 ml was 39% incidence rate. The associations between gender, age (<60 vs ≥60), and surgery type (cranial vs spine) and PVR1 were significant Figure 1. In addition, the difference between cranial and cervico-thoracic surgery types was significant. Positive trends were also seen for duration of anesthesia (≤200 vs >200 minutes), lumbar vs cervico-thoracic and lumbar vs cranial, and beta blockers. Twenty-three patients had a diagnosis of DM with an average PVR1 of 363 ml compared with no diabetic patients with a PVR1of 245 ml (P = 0.10) Figure 1 This difference was not statistically significant, however, it showed a positive trend. A positive association was seen with NBIOIVF measurement (r = 0.156, P = 0.072) Figure 2. In PVR1 between patients with BMI greater than 30, being on selective alpha blockers (males only), or anticholinergic as home medication had no differences among these variables. Furthermore, PVR1 was positively associated with length of stay (r = 0.176, P = 0.04) Figure 3.

Gender, duration of anesthesia, and surgery type (spine vs cranial) were remained significant in regression analysis when considering all patient characteristics (except selective alpha blockers). Duration of anesthesia over 200 minutes and spine vs cranial surgery remained significant in female patients (Table 2) 24 patients had IUCs reinserted postoperatively or should have had one (5 refused and 2 had a third PVR) out of 137 patients. The association was found between IUC reinsertion with gender was significant, with men having more chances of reinsertion than females (28% vs 7%, P = 0.001). An association can be seen with patients greater than 60 years as compared with younger patients having higher reinsertion rates (25% vs 12%, P = 0.055), and longer duration of anesthesia (>200 minutes) vs shorter (≤200 minutes) being associated with higher reinsertion rates (23% vs 11%, P = 0.069). Types of surgery, location of surgery, spinal area involved, DM positive, beta blockers, BMI, and anticholinergic agents were not associated with IUC reinsertion significantly. The differences between patients with and without IUC reinsertion were significant for PVR1 and NBIOIVF, with patients with IUC reinsertion having higher values compared with patients without IUC reinsertion for both variables Table 4

Table 1: Patient characteristics for all patients (n=137)

Patient characteristics	
Age, mean (s.d.)	57.5 (14.1)
Median (range)	57 (28-95)
Over 60 years of age, *n* (%)	56 (41%)
Male, *n* (%)	68 (50%)
Duration of anesthesia in minutes, mean (s.d.)	225.4 (95.7)
Median (range)	205 (44-719)
Surgery with duration of anesthesia over 200 minutes, *n* (%)	74 (54%)
Surgery type, *n* (%)	
Cranial	19 (14%)
Cervical/thoracic	45 (33%)
Lumbar	73 (53%)
Diabetes, *n* (%)	23 (17%)
Beta blockers, *n* (%)	27 (20%)
Antichol, *n* (%)	14 (10%)
Flomax/hytrin (males only), *n* (%)	9 (13%)
BMI>30, *n* (%)	58 (42%)
PVR, Mean (s.d.)	265 (242.9)
Median (range)	195.5 (0-1000)

BMI: Body mass index; PVR: Postvoid residual

Figure 1: The association of initial postvoid residual with gender, age, length of anesthesia, type of surgery, presence of preoperative diagnosis of diabetes mellitus, body mass index, and being on beta blockers, or anticholinergic agents preoperatively.

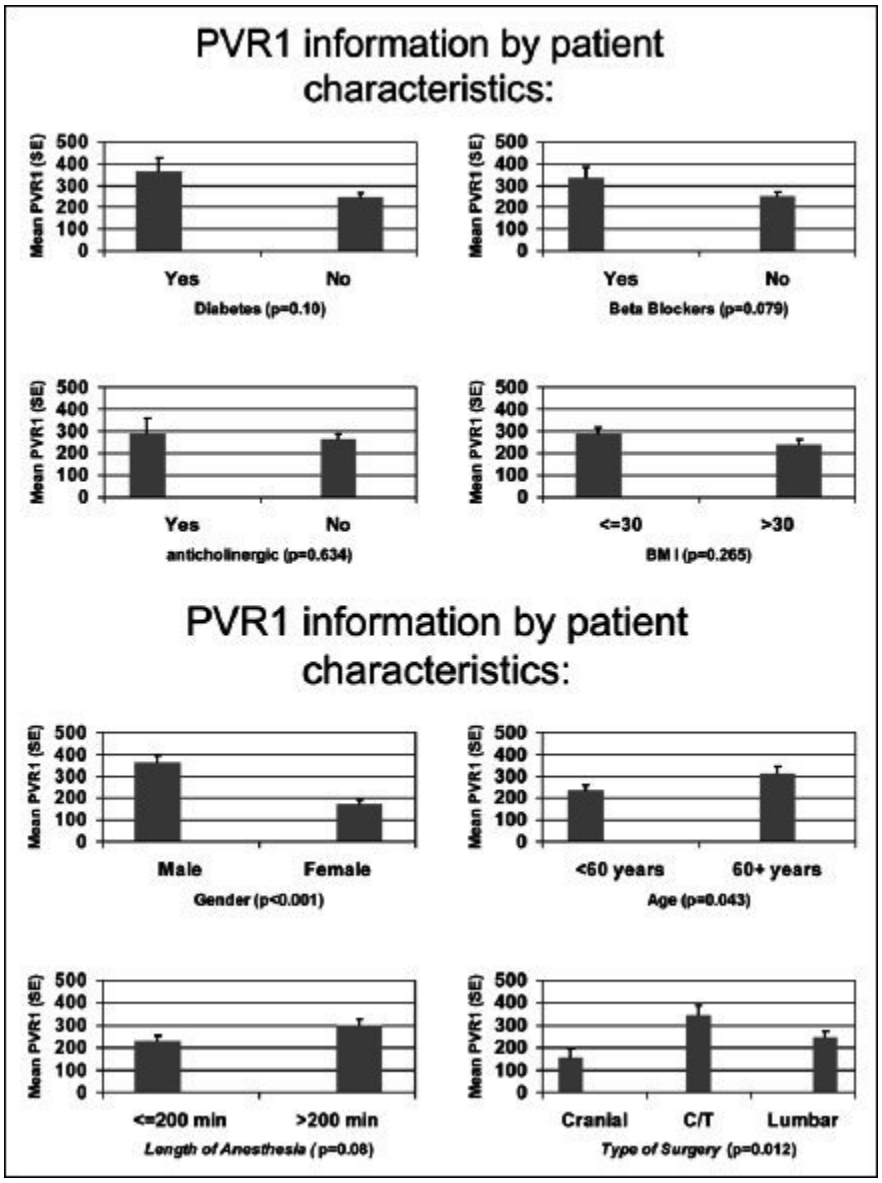

Figure 2: The association between initial post void residual and net balance of intraoperative intravenous fluid and initial post void residual

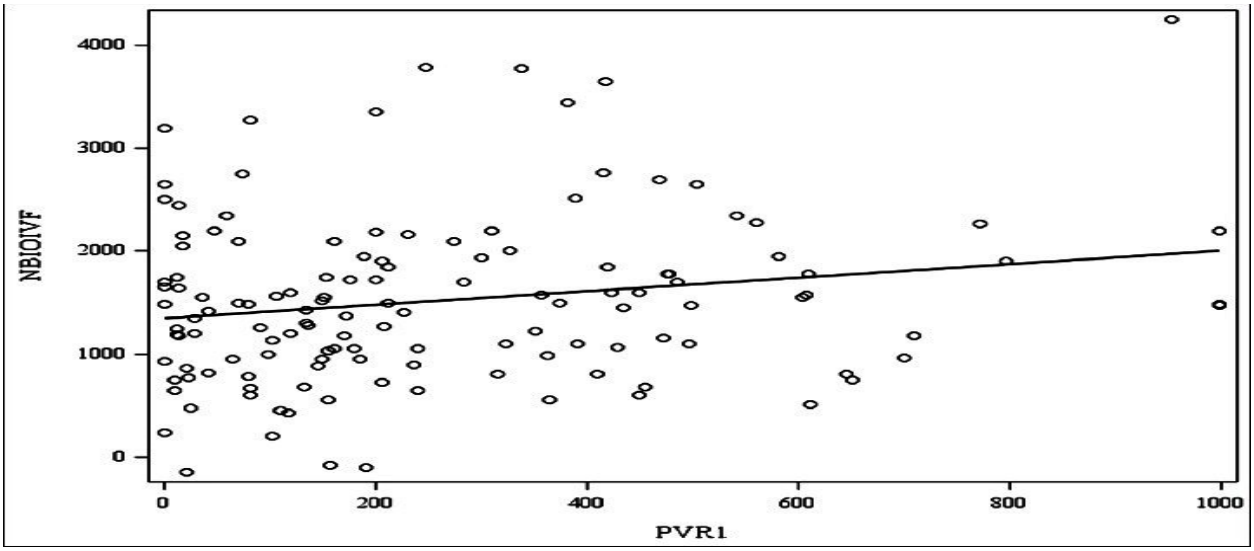

Table 3:The association of initial postvoid residual and length of stay

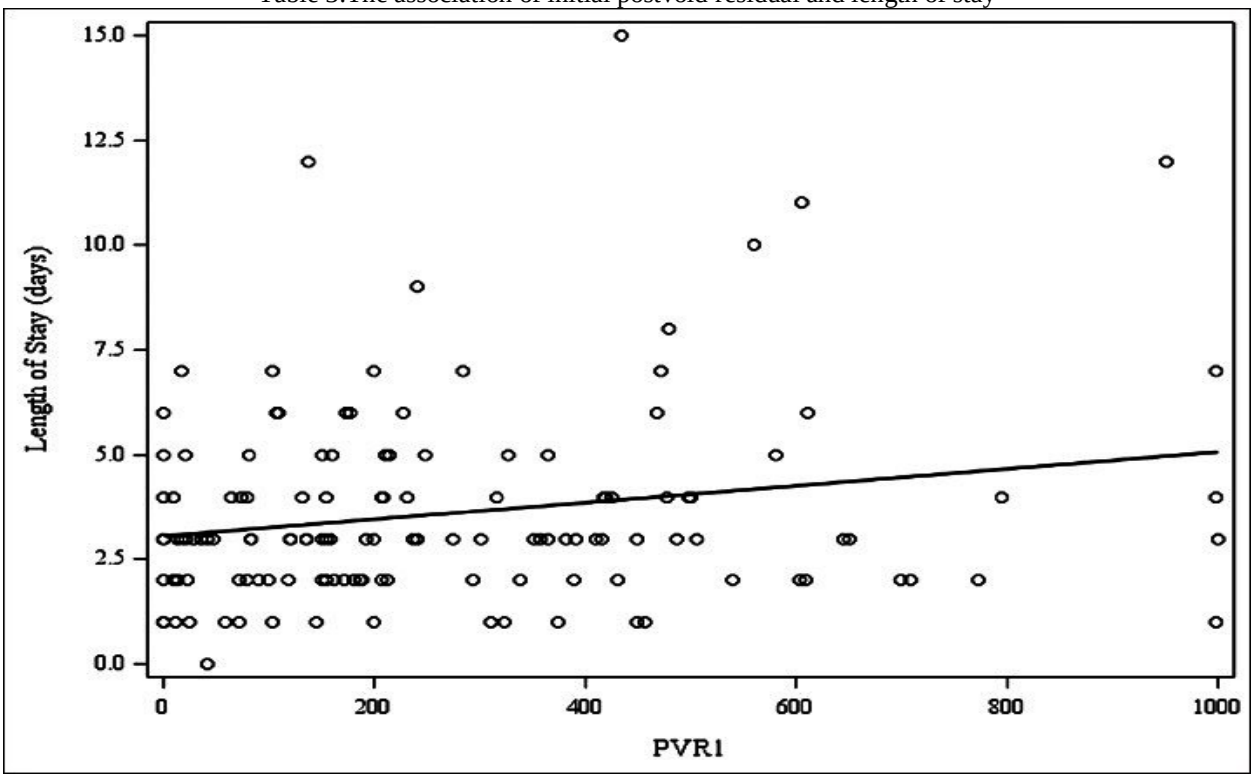

Table 2: Regression results for PVR1

Variable	All patients (*n*=137)			Females only (*n*=69)		
	Parameter estimate	Standard error	*P* value	Parameter estimate	Standard error	*P* value
Intercept	141.4	33.4	<0.001	120.6	31.5	<0.001
Male gender	193.4	37.1	<0.001			
Duration of anesthesia>200 minutes	91.2	37.7	0.017	125.9	43.1	0.004
Spine surgery (all spine vs cranial)	147.7	54.2	0.0073	135.8	60.9	0.029

Table 3: IUC reinsertion rates by patient characteristics

Variable	Response	*N*	IUC reinsertion (*N*=24) (%)	*P* value
Gender	Female	69	5 (7)	0.001
	Male	68	19 (28)	
Age	<60 years	81	10 (12)	0.055
	>=60 years	56	14 (25)	
Duration of anesthesia	<=200 minutes	63	7 (11)	0.069
	>200 minutes	74	17 (23)	
Surgery location	Cranial	19	1 (5)	0.315
	Cervical/thoracic	45	9 (20)	
	Lumbar	73	14 (19)	
Diabetes	No	114	18 (16)	0.236
	Yes	23	6 (26)	
Beta blockers	No	110	17 (15)	0.200
	Yes	27	7 (26)	
Anticholinergic medications	No	123	22 (18)	0.737
	Yes	14	2 (14)	
BMI	<=30	79	13 (16)	0.703
	>30	58	11 (19)	

BMI: Body mass index, IUC: Indwelling urinary catheter

Table 4: Association of IUC reinsertion with PVR and NBIOIVF

Variable	IUC reinsertion (*n*=24)	No IUC reinsertion (*n*=113)	*P* value
PVR			
Mean (S.D.)	587.4 (251.7)	199.4 (181.6)	<0.001
Median (range)	505 (160-1000)	155 (0-772)	
NBIOIVF			
Mean (S.D.)	1844.8 (188.5)	1450.6 (804.7)	0.014
Median (range)	1775 (505-4250)	1400 (-150 to 3790)	

IUC: Indwelling urinary catheter; PVR: Postvoid residual; NBIOIVF: Net balance of intraoperative intravenous fluid

DISCUSSION:

POUR is common among different neurosurgical patients and may be a major source of pain, infection, and increased cost. Although Boulis *et al.*[3] did not find a significant association between males and females, this study shows male gender has a major risk factor in developing POUR in the neurosurgical effected patients, previous findings reported in other surgical subspecialties. Due to damage of the autonomic nerve rectal procedures are associated with high rates of POUR, which sometimes happens during total mesorectal excision. Higher rates of PVR1 were seen in patients who underwent cervical or thoracic surgeries as opposed to cranial procedures. The trend of increased retention following cervico-thoracic surgeries compared with lumbar surgeries may be due to damaged spinal cord fibers.

Although all of our patients underwent general anesthesia, evidence suggests that techniques and length of anesthesia correlate well with increased incidence of POUR. Cortical micturition center is effected by sedative agents and leading to suppression of detrusor contraction and the micturition reflex. McLain *et al*.and Jellish *et al.* documented that only 8% and 14.8% incidence of POUR in patients who underwent spinal anesthesia, respectively. DM has been play role in the impairment of bladder sensation, capacity of bladder, and decreased contractility of bladder, which would lead to higher incidence of POUR.

Urinary retention is a famous most frequent side effect of anticholinergic agents. Such agents lead to impaired bladder contractility by working on the cholinergic receptors in the detrusor smooth muscle fibers. Although we failed to show a significant difference among our patients who were on home anticholinergic agents, the use of such agents intraoperatively has been hypothesized to increase the incidence of POUR. The use of the beta blockers has been weakly associated with POUR in neurosurgical patients. If patients were on beta blockers they showed a higher PVR1 (not statistically significant, $P = 0.079$). Such a trend may be due to the effect of beta receptors on the bladder neck, which led to decreased contractility. Males did not show lower volumes of PVR1 Who were on the treatment for BPH and taking alpha blockers.

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Boulis *et al.* found POUR to be associated with longer hospital stay in 503 patients who underwent spine surgery ($P < 0.01$). Among those with

retention, the median difference between observed and expected stay was 1 day. Balderi *et al*. noticed that patients who developed POUR had a median duration of stay of 7 days compared with 6 days only in patients who did not develop POUR ($P = 0.007$). In our patients, PVR1 >250 was positively associated with length of stay.

CONCLUSION:

POUR is prevalent among neurosurgical patients, Males, duration of anesthesia >200 minutes, increase in age, and spinal surgery are the most important risk factors associated with POUR in neurosurgical patients. It may causes the chances of high rates of infection, complication, cost, and longer hospital stay.

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