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# Effect of Early Removal of Urinary Catheter in Patients Undergoing Abdominal and Thoracic Surgeries with Continuous Thoracic Epidural Analgesia on Postoperative Urinary Retention

Ahmed Alwali[a] Ernst Klar[a] Imad Kamaleddine[a] Aenne Glass[b]
Matthias Leuchter[a] Clemens Schafmayer[a] Eberhard Grambow[a, c]

[a]Department of General, Visceral, Thoracic, Vascular and Transplant Surgery, University Medical Center Rostock, Rostock, Germany; [b]Institute for Biostatistics and Informatics in Medicine and Ageing Research, University Medical Center Rostock, Rostock, Germany; [c]Department of Cardiovascular and Thoracic Surgery, University of Goettingen Medical Center, Goettingen, Germany



**Keywords**
Urinary catheter · Urinary tract infection · Epidural catheter · Urinary retention · Enhanced Recovery After Surgery

**Abstract**

***Background:*** Postoperative continuous thoracic epidural analgesia (TEA) is an integral aspect of pain management after major abdominal and thoracic surgery. Under TEA, postoperative urinary retention (POUR) is frequently noted, prompting a common practice of maintaining the transurethral catheter (UC) until the cessation of TEA to avoid the necessity for reinsertion of the UC. This study analyzes the effect of an early bladder catheter removal during TEA on POUR incidence. ***Methods:*** The retrospective study was conducted on 71 patients undergoing elective abdominal and thoracic operations with TEA for postoperative pain control. Patients were divided into two groups based on the UC removal time in relation to the epidural catheter removal. In the early removal group (ERG), the UC was removed within 3 days of surgery, while in the standard group (SG), it was removed after completion of TEA. All patients in the ERG were still receiving TEA at the time of the UC removal. The primary outcome assessed was the incidence of POUR, while secondary outcomes included urinary tract infections (UTI), hospital length of stay (LOS), and patient's comfort. ***Results:*** The overall prevalence of POUR was 7%, with five POUR cases – two (4.9%) of 41 patients in SG and three (10%) of 30 in ERG ($p$ = 0.644). No significant difference was found in POUR occurrence between ERG and SG ($p$ = 0.644). Additionally, no UTIs were observed in the study. The postoperative pain scores (visual analog scale [VAS]) 72 h and 96 h and the LOS (SG: 16.74 [±8.39] days; ERG: 14.53 [±6.99] days; $p$ = 0.3) were similar between both study groups. ***Conclusion:*** Based on our results, it can be concluded that the removal of UC in the early postoperative period, even during TEA, can be performed safely without significantly increasing the risk of recatheterization.



## Introduction

Continuous thoracic epidural analgesia (TEA) has established itself as an invaluable tool in perioperative pain management for patients undergoing major abdominal or thoracic surgeries [1, 2]. Despite its benefits, it is also associated with negative side effects, including urinary retention [3]. To prevent this issue, many clinics routinely leave a urethral catheter (UC) in place as long as the TEA is in situ and functional [4].

Nevertheless, this approach contradicts the Enhanced Recovery After Surgery (ERAS) concept, which advocates

karger@karger.com
www.karger.com/vis



Correspondence to:
Ahmed Alwali, ahmed.alwali@med.uni-rostock.de

for early removal of the UC to promote postoperative mobilization and recovery. While the ERAS concept has proven beneficial and is widely accepted, there are still significant differences in certain aspects of the postoperative treatment pathway, particularly regarding the timing of UC removal [5]. In this context, early removal of UC under TEA may be associated with a potentially increased risk of postoperative urinary retention (POUR) and, respectively, related complications following early catheter removal [6–9]. However, only a few studies have analyzed the impact of postoperative management involving UC removal and the discontinuation of the TEA. This study investigated the safety and feasibility of an early UC removal after major abdominal or thoracic surgery and under a TEA.

## Material and Methods

This retrospective study was conducted on 71 consecutive patients who underwent abdominal or thoracic surgeries in a single institution at the Department of General, Visceral, Thoracic, Vascular and Transplant Surgery, University Medical Center Rostock, between January and December 2016. Based on the pooled prevalence of POUR after abdominal, pelvic, or anorectal surgery, as described by Baldini et al. [3] we expected the rate of POUR in the early removal group (ERG) to reach approximately 40%, while we expected a low prevalence of POUR in the standard group (SG) (~5%). Therefore, we assumed to detect a 35% difference in POUR rates between the two study groups with an 80% power by including at least 22 patients per group. Thus, we included patients over a period of 1 year backward. The medical records of all patients were reviewed in detail. The inclusion criteria were as follows: ≥18-year-old patients who underwent an open or laparoscopic abdominal or thoracic surgery as an elective procedure, and who received a TEA. Exclusion criteria included patients under 18 years, with pre-existing urinary incontinence or surgery, who had prior or intraoperative bladder resections or injuries necessitating prolonged urinary drainage, by whom TEA was withdrawn <72 h post-operatively, or patients requiring prolonged postoperative monitoring of urinary output for other reasons.

The retrospective data collection included a variety of demographic and perioperative data. These included age at the time of surgery, gender, body mass index, existing comorbidities, American Society of Anesthesiologists (ASA) classification, type of surgery, surgical access (laparoscopic or open), procedure's duration, intraoperatively infused fluid volumes, insertion height of the TEA, infusion rate of the TEA at the time of catheter removal, occurrence of POUR and assessment of patient's comfort using the visual analog scale pain score and the occurrence of urinary tract infection (UTI). The Charlson Comorbidity Index (CCI) was used to assess the pre-existing comorbidities of each patient.

Major abdominal surgeries were defined as partial or complete colectomies, rectum resections, pancreatic head and pancreatic partial resections, liver segment resections, gastrectomies, small bowel resections, and splenectomies. Data were obtained from electronic patient charts (COPRA, version 6.78.2.0 and 5.24.974; COPRA System GmbH, Sasbachwalden, Germany) and the clinical database (SAP, version 7300.1.3.1079, Walldorf, Germany).

The primary endpoint was the incidence of POUR after the UC removal in relation to epidural analgesia. In this retrospective study, POUR was defined as urinary retention necessitating the reinsertion of a UC 6–12 h after the catheter's removal. A UC was reinserted if patients experienced pain in the lower abdomen, a feeling of pressure, or a feeling of fullness as a symptom of POUR. Sonographic determination of residual urine was not performed routinely. The secondary endpoint was the occurrence of postoperative UTI. In addition, both the hospital length of stay (LOS) and patient's comfort were assessed. Thereby, the patient comfort was quantified through daily documentation of visual analog scale (VAS) pain scores by the pain management team.

A total of 71 patients were identified and included in the study. Patients were divided into two groups based on the timing of UC removal in relation to the TEA removal:

- SG: UC removal after discontinuation of TEA.
- ERG: UC removal up to 72 h after surgery under TEA.

All patients in the ERG had an ongoing TEA at the time of UC removal.

*Statistical Analysis*

Descriptive statistics are given as mean ± standard deviation and median (Q1–Q3), respectively, for quantitative variables, and as frequency (%) for qualitative ones. Normal data distribution was assessed by Shapiro-Wilk. Differences between groups were analyzed by the Mann-Whitney U test and for proportions by $\chi^2$ or Fisher's exact test (2 × 2). A significance threshold of $p < 0.05$ was set for statistical significance. All statistical analyses were performed using IBM® SPSS® 29.0 [10].

## Results

In this study, the 71 patients in total were divided into two cohorts according to the UC's removal timing. The ERG ($n$ = 30) had the UC removed within 3 days postsurgery, whereas the SG ($n$ = 41) had the UC removed after the discontinuation of TEA. In all retrospectively examined patients, the epidural catheter was inserted in the induction phase by the anesthesia team before the operation. The catheter insertion site was checked daily by the pain team and the pain scale using the VAS score. Mobilization outside the bed began on the first postoperative day under the guidance of a nurse or a physiotherapist. The TEA was discontinued by the pain team. The TEA was administered using ropivacaine 0.2% + 10 µg of sufentanil. The bolus dose administered was 2 mL, with a basal infusion rate set between 6 mL and 8 mL/h, adjusted once daily according to the pain scale by the pain management team.

*Postoperative Urinary Retention*

The overall incidence of POUR was 7% (5/71). The incidence of POUR was not significantly increased in the ERG compared with SG, with 3 (10%) of 30 patients versus 2 (4.9%) of 41, respectively ($p$ = 0.644). Patients with POUR were older than those who did not develop POUR (median age 71.5 [71–77] years vs. 65.5 [58–71] years). 9% of males and 4% of females developed POUR

**Table 1.** Comparative analysis of characteristics between POUR and non-POUR groups

| | POUR group ($n$ = 5) | Non-POUR group ($n$ = 66) | $p$ value |
|---|---|---|---|
| Age at time of operation, median, years | 71.8 (71–77) | 64.5 (58–71) | 0.177 |
| Sex | | | 0.656 |
| Male | 4 | 43 | |
| Female | 1 | 23 | |
| BMI, median | 25.20 (21.2–29.7) | 26.3 (22.5–27.8) | 0.813 |
| Intraoperative fluid volume administered, median, mL | 3,490 (2,650–4,400) | 3,147 (2,012–3,600) | 0.386 |
| Operation time, median, min | 222 (180–232) | 218 (140–297) | 0.785 |
| Time of removal of the urinary catheter | | | 0.644 |
| Before removal of epidural catheter | 3 | 27 | |
| After removal of epidural catheter | 2 | 39 | |
| Length of hospital stay, median | 18 (16.25–20) | 15.5 (10–20) | 0.577 |
| Type of surgery | | | 0.052 |
| Thoracic | 1 | 22 | |
| Abdominal (colorectal excluded) | 0 | 25 | |
| Colorectal | 4 | 19 | |
| Colorectal | | | 0.317 |
| Rectum | 3 | 8 | |
| Colon | 1 | 11 | |

POUR, postoperative urinary retention; BMI, body mass index.

(Table 1). Regarding the surgical procedure's type, 60% (3/5) of the patients who developed POUR had a low anterior rectal resection. Although not statistically significant, in the ERG, patients who developed POUR had a higher rate of epidural infusions at the time of UC removal (6 mL/h vs. 4.6 mL/h; $p$ = 0.193).

*Patient Characteristics and Perioperative Parameters*

The distribution of age, gender, body mass index, and comorbidities are shown in Table 2. No significant differences were found between SG and ERG. Furthermore, no statistically significant differences were found between the groups in the analysis of preoperative comorbidities, ASA classification, and CCI. The proportion of patients with benign prostatic hyperplasia (BPH) was also similar in both groups ($p$ = 0.4457). An abdominal operation was performed in 67.6% ($n$ = 48) of the cases, while the remaining 32.4% ($n$ = 23) were thoracic surgical procedures. The type of surgical procedure performed was significantly different between both groups ($p$ < 0.001). In patients who underwent a thoracic surgical operation, the UC was more often removed before the TEA removal. The perioperative parameters of each group are shown in Table 3.

*UTI, Hospital LOS, and Patient's Comfort*

None of the 71 patients developed a UTI during their hospital stay. LOS was similar for patients in the SG (16.74 ± 8.39 days) and ERG groups (14.53 ± 6.99 days; $p$ = 0.300).

In total, there were no differences in VAS scores between the SG and ERG groups regarding the pain intensity at rest (VAS-R) or during coughing or exertion (VAS-B) at different time periods. In detail, on the day after UC removal (96 h: VAS-R; $p$ = 0.398 and VAS-B; $p$ = 0.324), and likewise on the day before, when the UC was still in situ in most patients (72 h: VAS-R; $p$ = 0.366 and VAS-B; $p$ = 0.891) (shown in Fig. 1). Similar results were detected in subgroup analyses for patients undergoing thoracic or abdominal surgery.

## Discussion

In this study, we investigated whether an early UC removal after a major abdominal or thoracic surgery under TEA has an impact on the incidence of POUR. We carried out a retrospective analysis of our own patients, over a year including a number of patients undergoing consecutively abdominal or thoracic surgical procedures. The study revealed that POUR incidence was not significantly higher in the ERG compared to the SG ($p$ = 0.644).

No UTI was documented in either group in this study. Early UC removal did not result in significantly reduced pain at rest or during coughing and activity on the day following removal between the two groups (SG vs. ERG). The hospital LOS was not significantly lower in the ERG than in the SG. Interestingly, we observed that 4 patients in the ERG and three in the SG had BPH, yet none of the patients who developed POUR had BPH. This finding

**Table 2.** Characteristics and comorbidities of the 71 retrospectively examined patients are similar in groups SG and ERG

| Characteristics | SG ($n$ = 41) | ERG ($n$ = 30) | $p$ value |
|---|---|---|---|
| Age at time of OP, years | 65.0 (60–75) | 65.5 (57–71) | 0.514 |
| Sex | | | 0.447 |
| Male | 29 | 18 | |
| Female | 12 | 12 | |
| BMI | 24.5 (21.6–27.8) | 27.1 (23.6–28.1) | 0.219 |
| Comorbidities | | | |
| Diabetes mellitus | 10 | 6 | 0.780 |
| Coronary heart disease | 3 | 3 | 0.692 |
| Arterial hypertension | 24 | 17 | 0.811 |
| Chronic kidney disease | 3 | 4 | 0.446 |
| Chronic obstructive pulmonary disease | 4 | 5 | 0.479 |
| Chronic heart failure | 1 | 3 | 0.304 |
| History of neoadjuvant therapy | 9 | 6 | 1.000 |
| Nicotine addiction | 5 | 3 | 1.000 |
| Obesity | 2 | 0 | 0.505 |
| Rheumatoid arthritis | 0 | 0 | 1.000 |
| Liver cirrhosis | 1 | 0 | 1.000 |
| BPH | 3 | 4 | 0.446 |
| ASA score (I/II/III/IV) | 1/20/18/2 | 0/9/21/0 | 0.079 |
| CCI | 5.0 (4–7) | 5.0 (4–7) | 0.878 |

SG, standard group; ERG, early removal group; BMI, body mass index; ASA, American Society of Anesthesiologists physical status classification system; CCI, Charlson comorbidity index.

**Table 3.** Perioperative parameters in the standard group (SG) and early removal group (ERG)

| | SG ($n$ = 41) | ERG ($n$ = 30) | $p$ value |
|---|---|---|---|
| Type of surgery, $n$ (%) | | | <0.001 |
| Abdominal, $n$ = 48 (67.6) | 36 (88) | 12 (40) | |
| Thoracic, $n$ = 23 (32.4) | 5 (12) | 18 (60) | |
| Access, $n$ (%) | | | 0.605 |
| Open surgery, $n$ = 50 (70) | 30 (73) | 20 (67) | |
| Laparoscopic surgery, $n$ = 21 (30) | 11 (27) | 10 (33) | |
| Operation time, median, min | 250 (184–332) | 165 (128–188) | <0.001 |
| Intraoperative fluid volume administered, median, mL | 2,790 (2,230–4,100) | 2,342 (1,780–3,100) | 0.036 |
| Epidural catheter duration, mean, days | 5.50 (±2.00) | 6.10 (±2.73) | 0.343 |
| Level of epidural catheter insertion | | | 0.138 |
| T 3–5 | 2 | 2 | |
| T 6–8 | 25 | 24 | |
| T 9–12 | 14 | 4 | |

aligns with some studies, such as Patel et al. [11] which did not find a significant association between BPH and POUR despite expectations to the contrary. BPH is often underdiagnosed, variably recorded during surgical admissions, and can vary widely in severity, making it challenging to study in this context. Thus, the apparent lack of association in our study may not be significant.

The optimal timing for the UC removal under TEA remains a topic of controversial discussion. Wagner et al. [4] conducted a survey among high-level German hospitals with general and/or visceral surgical departments regarding current practices concerning UC and TEA. The analysis highlighted the lack of standardization in timing, with no consensus on the best practice.

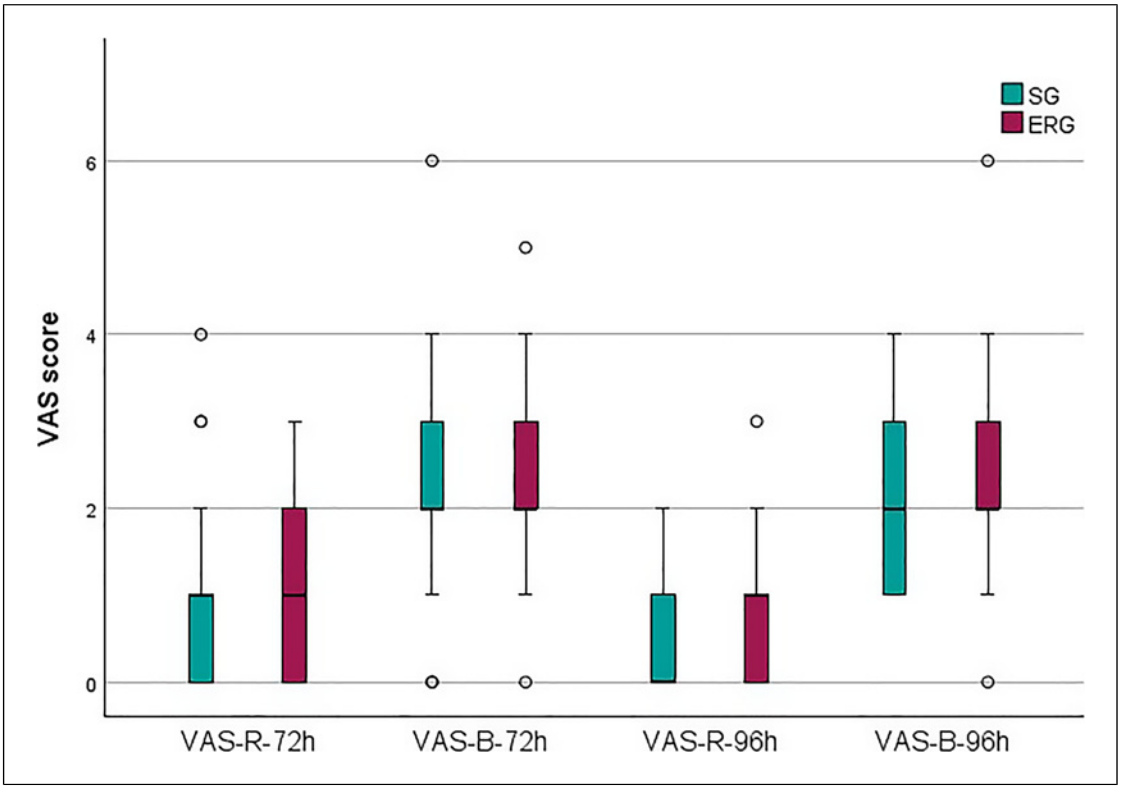


**Fig. 1.** Comparison of pain intensity with visual analog scale (VAS score) between standard group (SG) and early removal group (ERG), on the day after bladder catheter removal (96 h) and likewise on the day before, when the bladder catheter was still in situ in (72 h). VAS-R, visual analog scale in rest. VAS-B, visual analog scale during exercise.

In the literature, there are only a few randomized studies addressing this question. Zaouter et al. [12] conducted a randomized study on patients scheduled for thoracic and abdominal surgery receiving TEA. They noted a marginally higher incidence of POUR with early UC removal, but this was not statistically significant. This aligns with our results, where the difference in POUR incidence between the ERG and SG also was not significant. Interestingly, in another study, the authors observed significantly higher residual urine volumes when catheters were removed early; however, this did not result in an increased need for recatheterization [13].

Coyle et al. [14] conducted a randomized study on patients undergoing colorectal surgery with TEA. They found that no females developed POUR, while it occurred in three males (20%) in the early UC removal group and in two males (22.2%) in the SG. Notably, all patients who experienced POUR had undergone rectal resection. This finding is consistent with our results, where 60% of patients who developed POUR had undergone rectal resection.

Schreiber et al. [15] reported in a prospective, non-randomized study that early UC during TEA after colorectal procedures is a risk factor for the development of POUR. In their study, 7.8% of patients who had their UC removed early on the first postoperative day required recatheterization due to POUR. Although the incidence of POUR was higher compared to the control group (2.6%), the possibility of early UC removal following colorectal surgery under TEA was considered. The authors also demonstrated that the impact of early UC removal on the incidence of POUR during TEA was particularly pronounced in patients undergoing rectal surgery, as opposed to colon procedures [15]. This result is in line with our study. Patients undergoing rectal resection might experience slower bladder recovery than those having colon resection due to the proximity of pelvic nerves to the surgical area [16, 17]. Early UC removal should be cautious or monitored closely as this group faces a significantly higher risk of developing POUR [14, 15].

After thoracic surgery, studies have shown varying incidences POUR, ranging from 0% to 26.7%, suggesting variability across different settings and patient populations [18–20]. Chia et al. [21] reported a prospective randomized study involving 78 patients scheduled for elective thoracotomy. In this study, no patient in either group required recatheterization for POUR, nor did they encounter UTI.

This study presents several limitations that should be taken into consideration. The most important limitation results from the retrospective design of the study. This

design lacks subject randomization and is susceptible to bias influenced by the surgeon's preferences. The considerable heterogeneity within the patient cohort can impact rates of POUR, UTI, LOS, and other outcomes. Additionally, the study's small sample size, attributed to the annual caseloads of the single center, represents another limitation. However, it encompasses a wide range of surgical procedures, including various forms of abdominal and thoracic surgeries, to analyze the entirety of visceral and thoracic surgical interventions. These factors could be addressed by conducting a similar study using a randomized, prospective design.

## Conclusion

Our data suggest that early UC removal under TEA does not significantly increase the incidence of POUR. However, due to the limitations of this study, including its retrospective design and small sample size, definitive conclusions about the optimal UC removal timing cannot be drawn. Further research is needed to establish clear guidelines and optimize patient outcomes in this context.

## Statement of Ethics

The study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki. This study protocol was reviewed and approved by the Rostock University Medical Center Ethics Committee, including an exception of obtaining written informed consent to participate (oral consent was obtained instead), Approval No. A 2018-0220.

## Conflict of Interest Statement

All authors declare no conflicts of interest for this manuscript.


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## Author Contributions

Ahmed Alwali: conception of the work, data acquisition, interpretation of the data, writing of the first draft of the manuscript, and revision of the manuscript. Ernst Klar, Clemens Schafmayer, and Eberhard Grambow: conception of the work, interpretation of the data, and revision of the manuscript. Imad Kamaleddine: data acquisition, interpretation of the data, and revision of the manuscript. Aenne Glass and Matthias Leuchter: statistical analysis, writing of parts of the manuscript, and revision of the manuscript. All authors have read and approved the manuscript.

## Data Availability Statement

All data generated or analyzed during this study are included in this article. Further inquiries can be directed to the corresponding author.

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