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Unrecognized Tube-Related Complications in Hospitalized Urological Patients

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Abbreviations: MFS: Morse Fall Score; BMI: Body Mass Index; MCCI: Modified Charlson Comorbidity Index; MMS: Must Malnutrition Score; IQR: Interquartile Range; SIR: Society of Interventional Radiology.

Abstract

Objectives: Draining tubes are an integral part of daily patient care in urological departments and a potential source of complications. We evaluated a shared responsibility-based safety protocol aimed at identifying tube-related errors and adverse events.

Methods: All patients hospitalized in the urology department of a tertiary hospital underwent visual examination by urology nurses during shift changes. All tubes and wounds were inspected and all adverse findings were documented. Patient demographics and clinical characteristics were recorded. The potential parameters associated with adverse findings were investigated using univariate and multivariate logistic regression analyses.

Results: Of the 184 patients examined over a 2-month period, 66 adverse findings were documented in 47 (25%). Urethral catheter-related findings were the most common (n= 38, 57%), with tube kinking and twisting occurring in 22 (33%) and nine (13%) cases, respectively. There were 16 (24%) nephrostomy tube-related events, including six (9%) kinks and three (5%) twists. In the multivariate analysis, tube duration (p=0.001; OR:1.37 [95% CI:1.13- 1.63]) and higher Morse fall score (MFS) (p=0.04; OR:1.02 [95% CI:1.01- 1.04]) were associated with tube-related adverse events.

Conclusion: Tube-related adverse findings were common among hospitalized urology patients, particularly among those with higher Morse fall score (MFS) and longer tube duration. The implementation of routine examinations by nursing staff can help detect tube-related errors and prevent further clinical sequelae.

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Introduction

Draining tubes are an integral part of daily patient care in urological departments. Catheters, drains, and stents are sources of infectious and non-infectious complications [1-4]. Strategies to prevent catheter-associated adverse events are commonly used in hospital settings [5,6]. For example, urethral catheter fixation was shown to reduce meatal complications [7]. Despite versatile preventive measures, tube-related complications remain a widespread problem.

Patient care is a team effort of nurses, nurse practitioners, physician assistants, and doctors. Close collaboration between health care professionals translates to improved patient well-being [8,9]. Nonetheless, the treating physician is primarily responsible for physical examinations, including catheter inspection and maintenance [10-12]. Technical and functional errors may go unrecognized during the long hours between physician rounds.

Establishing shared responsibility between physicians and nurses for patient checkups may reduce complications and improve patients' safety. Emphasis on nursing education, training, and empowerment has already been shown to reduce catheter-associated morbidities [13,11,12].

We hypothesized that a brief visual patient examination during nurses' shift change will enable the identification and correction of tube-related errors and hazardous events. We implemented such a safety protocol, led by urology nurses, and describe its results.

Methods

A cross-sectional design was utilized. During the morning and afternoon nurses shift changes, hospitalized urology patients were asked to remove their blankets for a brief physical inspection that would include their tubes and surgical wound state. All adverse findings were recorded and corrected as required.

Patients and data collection

The study population included all patients aged 18 years or older, who were hospitalized in the urology department of a tertiary referral center between 19 July 2020 and 3 October 2020.

Data was collected on any tube-related adverse event, including detachment or lack of proper instrument fixation, kinking or bending of the tube on itself, twisting of the tube or wire around a patient's body, leakage around the drains or catheters, and clogged collection bags due to tangling or displacement. Any signs of wound complication were recorded as well. Demographics and clinical characteristics were recorded including comorbidities, time with the catheter/tube, length of hospitalization, and the type of procedure performed. For each patient, we calculated Body Mass Index (BMI), Modified Charlson Comorbidity Index (MCCI), and Morse and MUST scores. The Morse score includes a six-item scale to assess the risk of falling and has been used as a tool to direct fall-prevention strategies 14]. The MUST malnutrition score is comprised of BMI, involuntary weight loss, and acute disease-preventing oral intake [15].

Statistical analysis

Categorical variables were summarized by number and percentage, and continuous variables by median and Interquartile Range (IQR). Association with adverse findings was tested by univariate and multivariate logistic regression analyses. Using features found to be significant ($p<0.1$) on univariate regression and variables of interest, a multivariable model was created for the prediction of any adverse event found by the nursing staff. All analyses were performed using Stata version 17.0 (Stata Corporation, College Station, TX). The study protocol was approved by our institutional ethics committee.

Table 1: Baseline characteristics of 184 hospitalized urology patients.

Characteristic	Total
No. of patients (%)	184 (100)
Age (years), median (IQR)	68 (57-75)
BMI kg/m², median (IQR)	26.03 (23-29)
Smoking (%)	34 (18)
Cognitive decline/dementia (%)	5 (3)
Steroids use (%)	10 (5)
Diabetes mellitus (%)	53 (29)
Modified Charlson comorbidity score, median (IQR)	4 (2-5)
Length of hospital stay (days), median (IQR)	4 (2-6)
Morse fall score, median (IQR)	15 (15-35)
Must malnutrition score, median (IQR)	0 (0-1)
Reason of admission	
Elective surgery (%)	131 (71)
*Other (%)	53 (29)
Robotic surgery	
Radical prostatectomy (%)	12 (7)
Partial nephrectomy (%)	2 (1)
Pyeloplasty (%)	2 (1)
Laparoscopic surgery	
Radical nephrectomy (%)	7 (4)
Partial nephrectomy (%)	7 (4)
Adrenalectomy (%)	3 (1.5)
Trans urethral surgery	
TURP (%)	13 (7)
TURBT (%)	41 (22)
TURBN (%)	4 (2)
Open surgery	
Radical cystectomy with ileal conduit formation (%)	8 (4.5)
Radical nephrectomy (%)	2 (1)
SPP (%)	2 (1)
Ureteral stent placement (%)	12 (7)
**Other surgical procedures (%)	49 (26)

Abbreviations: **IQR:** Inter-Quartile Range; **TURP:** Trans Urethral Resection Of Prostate; **TURBT:** Trans urethral resection of bladder tumor; **TURBN:** Trans Urethral Resection Of Bladder Neck; **SPP:** Suprapubic Prostatectomy; **BMI:** Body Mass Index.

*Other reasons for admission: renal colic, hematuria, post-operational complication, urinary tract infection, and further workup.

**Other surgical procedures: procedures including nephrostomy tube placement, kidney biopsies, focal therapy for prostate cancer, prostate fusion biopsies, female urology, and testes surgery

Results

A total of 184 patients were hospitalized during the study period with a median age of 68 (inter-quartile range [IQR]: 57-75) years, and 45 (25%) had pre-existing catheters or tubes. The median hospital stay was 4 (IQR: 2-6) days and 131 (71%) patients were admitted for elective surgery. Fifty-eight patients underwent transurethral endoscopic procedures, 33 robotic or laparoscopic surgeries, and 12 open surgery. Patient characteristics are summarized in **Table 1**.

A total of 268 tubes were inspected by the nursing staff, including 151 (56%) urethral catheters, 39 (15%) surgical drains, 36 (13%) nephrostomy tubes, 17 (6%) urostomy bags, 11 (4%) ureteral catheters, and 3 (1%) supra-pubic catheters.

There were 66 errors found in 47 (25%) patients. Among these, 38 errors (57%) were urethral catheter-related. The median urethral catheter duration time was 3 (IQR: 2-4) days, during which tube kinking and twisting were noticed in 22 (33%) and 9 (13%) catheters, respectively **(Figure 1)**. In 1 (1.5%) patient the Foley catheter was misplaced with the balloon partially inflated, suggesting it was in the urethra **(Figure 2)**. From 36 nephrostomy tubes inspected during a median duration of 3 (IQR: 2-10) days, 16 (24%) tube-related events were reported, including 6 (9%) kinking of the tube on itself and 4 (6%) tangling of the collection bag. Thirty-nine surgical drains were inspected during a median duration of 3 (IQR: 3-6) days. There were 4 (6%) problems found, including one leakage around the drain, one kinking, and two overfull collection reservoirs.

Other adverse findings included surgical wound discharge in 4 (6%) patients, twisted central venous catheter in 1 (1%) patient, and 1 (1%) empty drug ampule found under a patient's blanket. A summary of all findings is shown in **Table 2**.

In univariate analysis, longer duration with the urethral catheter was associated with adverse urethral catheter event (p=0.01) and any adverse event (p=0.001). Higher MORSE scores (p=0.05) were associated with adverse urethral catheter events.

In multivariate analysis, longer urethral catheter duration and higher MORSE score remained predictive for urethral catheter-related adverse events [(p=0.02; OR: 1.25 [95% CI: 1.03- 1.51]) and (p=0.03; OR: 1.02 [95% CI: 1.01- 1.04]), respectively] and any adverse event [(p=0.001; OR: 1.37 [95% CI: 1.13- 1.63]) and (p=0.04; OR: 1.02 [95% CI: 1.01- 1.04]), respectively] **(Table 3)**.

Table 2: Adverse tube- and wound-related findings.

	Number of instruments (%)	Duration of instrument presence (median) days	Patients with adverse findings (%)	Adverse findings (%)	
Total	268 (100)		47/184 (25)	66 (100)	
Urinary catheters	151 (56.5)	3 (IQR: 2-4)	31 (17)	Total	38 (57.5)
				Kink	22 (33.5)
				Twist	9 (13.5)
				Collection bag tangle	6 (9)
				Partially inflated balloon	1 (1.5)
Surgical drains	39 (14.5)	3 (IQR: 2.75-6)	3 (1.5)	Total	4 (6)
				Kink	1 (1.5)
				Full reservoir	2 (3)
				Leakage	1 (1.5)
Nephrostomy tubes	36 (13.5)	3 (IQR: 2-10)	8 (4.5)	Total	16 (24.5)
				No fixation	2 (3)
				Kink	6 (9)
				Twist	3 (5)
				Collection bag tangle	4 (6)
				Infection	1 (1.5)
Urostomy bags	17 (6)	4 (IQR: 2-11.57)	2 (1)	Total	2 (3)
				Collection bag twist	2 (3)
Ureteral catheters	11 (4)	9 (IQR: 3.25-10)	0	-	-
Suprapubic catheters	3 (1)	11 (IQR: 3-11)	0	-	-
Central venous catheters	5 (2)	3 (IQR: 2.5-4.5)	1 (0.5)	Total	1 (1.5)
				Twist	1 (1.5)
* Other instruments	6 (2)	6.5 (IQR: 2.5-11.25)	0	-	-
Other adverse findings	-	-	5 (3)	Total	5 (7.5)
				Wound discharge	4 (6)
				Drug ampule	1 (1.5)

Abbreviations: IQR: Inter-Quartile Range

*Other instruments - including colostomy, ileostomy, feeding tubes, ureteral catheter

Table 3: Univariable and multivariable analyses for the risk of tube related adverse findings.

Factors	Univariable analysis		Multivariable analysis	
	Odds ratio (95% CI)	p-value	Odds ratio (95% CI)	p-value
Sex (male)	1.55 (0.68-3.52)	0.29	-	-
Age (years)	0.99 (0.97-1.02)	0.7	0.97 (0.94-1.01)	0.7
BMI (kg/m²)	1.04 (0.96-1.12)	0.26	1.05 (0.97-1.14)	0.2
Non smoker	0.89 (0.54-1.48)	0.67	-	-
Cognitive decline/dementia	0.99 (0.15-6.50)	0.99	-	-
Steroids use	1.24 (0.25-6.19)	0.78	-	-
Duration of tubes presence (day)	1.35 (1.13-1.60)	0.001	1.37 (1.13-1.63)	0.001
Modified Charlson Comorbidity Index	1.09 (0.93-1.28)	0.26	-	-
Morse fall score	1.02 (0.99-1.03)	0.06	1.02 (1.01-1.04)	0.04
MUST malnutrition score	1.34 (0.66-2.74)	0.41	-	-

Abbreviations: CI: Confidence Interval; **BMI:** Body Mass Index

Figure 1: Kinking and twisting of a urethral-catheter drainage tube.

Discussion

We proposed a practical, simple, and safe protocol to identify tube-related errors in hospitalized urological patients. Routine inspections by urology nurses led to the identification of adverse events in 25% of examined patients. Longer tube duration and higher MORSE scores were associated with these adverse findings.

The prevalence of tube-related complications in urology departments is largely unknown and likely under-reported. The literature on non-infectious drainage tube complications is scarce, with best practice recommendations for prevention and management based only on small case series [17,18]. For example, Turo et al. reported on nephrostomy tube-related complications. They analyzed a cohort of 66 hospitalized patients and found tube dislodgment, site infection, and tube blockage in 6% of patients [17]. This is similar to the 4.5% nephrostomy tube-related complications in our study that included kinking of the tube on itself, twisting around the patient's body, and tangling of the collection bag. Importantly, 5% of the patients in Turo's report developed serious complications, such as sepsis and hemorrhage, which were not noticed in our cohort.

Figure 2: Lack of urethral-catheter fixation with improper balloon inflation.

The Society of Interventional Radiology (SIR) classifies tube-related complications into six categories, according to their severity [19,20]. While minor complications (categories A and B) require nominal or no therapy, major complications (categories C to F) require additional therapy with an increase in the level of care or prolonged hospitalization. The main aspect for consideration is early identification of early minor complications to prevent potential deterioration to major complications.

We found that minor complications are common and occur in 1/4 (25%) of hospitalized urological patients. The most common adverse events were kinks and twists of urethral catheters. It has been shown that if left unfixed, kinks and twists can cause blockages and result in kidney injury and infections [21,22,23] Furthermore, although the lack of urethral-catheter fixation was not included in our analysis, it was a very common observation. Even if not considered a complication per se, improper catheter fixation has been linked to increased risk for meatal pressure injury and iatrogenic hypospadias [7].

Typical for a tertiary hospital department of urology, most patients in this study underwent transurethral endoscopic procedures or minimally invasive laparoscopic surgery. Despite the established advantage of shorter hospital stay tubes related errors were noticed in 31/102 (30%) patients during 1-3 hospitalization days. Although basic patient demographics did not predict adverse tubes- related events, a composite of patient

characteristics, represented by the MORSE score, was strongly associated with such events.

MORSE score is a potential predictor of postoperative morbidity and is often used to classify patients to improve postoperative care [24,25] found higher MORSE scores among women who experienced complications after urogynecology surgery. Their primary outcome was grade II or greater complication on the Clavien-Dindo scale [25]. Because the MORSE scale evaluates frailty, the association with tube-related errors is to be expected.

Tube duration is a well-known risk factor for complications. Saint et al. reported a 20% increase ($p<0.001$) in non-infectious complications among patients with longer than three days duration of urethral catheter [1]. In our study, the median tube duration was twice as long in patients with adverse events as compared to in those without adverse events (5 versus 2.5 days). The association between tube duration and complications was confirmed in our multivariate analysis.

Our study is the first to prospectively evaluate the identification of any tube-related errors by urology nursing staff. This yielded a significant number of inspected catheters and tubes (n=268). Focusing on urethral catheters, [11] implemented a nursing education program for catheter insertion and maintenance. They showed a 5-fold decrease in iatrogenic urethral injuries. Our data supports that finding and demonstrates a substantial number of errors uncovered and corrected by urology nursing staff.

The main limitation of our study is the lack of a control group. Although this observational study provides important data about the proportion of tube-related errors and their risk factors, the clinical implications of these findings are not definitive. Previous studies strengthen our hypothesis that improved monitoring and early identification of minor complications decreases the risk of more serious complications such as uncontrolled tube extraction, tube blockage, and infections [26,27].

Moreover, collaborating with the urology nursing team rather than relying solely on the physician's physical exam proved to be an effective strategy to uncover adverse findings.

In conclusion, tube-related complications are common among hospitalized urology patients and were identified during nurse's shift change rounds in 25% of examined patients. We, therefore, recommend that a brief visual exam of all indwelling tubes be performed routinely during nurses rounds, especially in patients.

Disclosures

Funding: This study did not receive any specific grants from funding agencies in the public, commercial, or not-for-profit sector.

Conflicts of interest: None.

Institutional Review Board (IRB) Approval: The study protocol was approved by the institutional ethics committee, with no Patients' consent form necessary.

Data access statement: All relevant data are included in the paper and its supporting information files.

What is already known about the topic?

- Catheters, drains, and stents are sources of infectious and noninfectious complications.
- Previous studies have shown that improved monitoring and early identification of minor tube-related complications decreases the risk of more serious complications.
- Close collaboration between health care professionals translates to improved patient well-being.

What this paper adds

- We evaluate a shared responsibility-based safety protocol aimed at identifying tube-related errors and hazardous events.
- This study was the first to prospectively evaluate the identification of tube-related errors by urological nursing staff.
- Collaborating with the urology nursing team, rather than relying solely on the physician's physical examination, proved to be an effective strategy for uncovering adverse findings.

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