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ORIGINALES

Impact of portable volumetric ultrasound on bladder catheterizations due to urinary retention in an internal medicine unit

Impacto de la ecografía volumétrica portátil en el sondaje vesical por retención urinaria en una unidad de medicina interna

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ABSTRACT:

Aim: To estimate the impact of the use of portable bladder volumetric ultrasound on bladder catheterization due to suspicion of urinary retention in an internal medicine unit.
Methodology: Study of retrospective cohorts, comparing the cohort exposed to the availability of bladder ultrasound, with the not exposed the previous year. All records in the Electronic Medical Record (EHR) of short-term permanent bladder catheters in adult patients admitted to the Internal Medicine hospitalization unit of the University Hospital Fundación Alcorcón (HUFA) during the years 2015 and 2016 were analyzed. The urinary retention frequency is estimated as the cause of the catheterization after the device has been incorporated into the unit and compared with the frequency of catheterization during the same period of the previous year in the same unit. It is estimated that the impact of having this device on the urinary retention frequency is the reason for the catheterization.
Results: 134 catheters are included in 113 patients, 62 in the group without ultrasound and 72 in the group with ultrasound. The frequency of catheterizations due to retention is reduced from 47.5% to 21.4% after introducing the ultrasound unit into the unit. This represents a 50% reduction (adjusted RR=0.48; CI95%:0.27-0.84, p=0.01) in the frequency of urinary catheterization for suspected urinary retention.

Key words: Catheters, Indwelling; Catheter-Related Infections; Urinary Catheterization; Device Removal; Urinary Retention; Urinary Bladder Diseases; Ultrasonography; Nursing Care.

RESUMEN:

Objetivo: Estimar el impacto que el uso de ecógrafo vesical tiene en los sondajes vesicales por sospecha de retención urinaria de una unidad de Medicina interna.
Metodología: Estudio de cohortes retrospectivas, comparando la cohorte expuesta a la disponibilidad del ecógrafo vesical, con la no expuesta el año previo. Se analizan todos los registros en la Historia Clínica Electrónica (HCE) de sondajes vesicales permanentes de corta duración en pacientes adultos

que ingresaron en la unidad de hospitalización de Medicina Interna del Hospital Universitario Fundación Alcorcón (HUFA) durante los años 2015 y 2016. Se estima la frecuencia de retención urinaria como causa del sondaje después de la incorporación del dispositivo en la unidad y se compara con la frecuencia en sondajes durante el mismo periodo del año anterior en la misma unidad. Se estima el impacto que disponer de este dispositivo tiene en la frecuencia de retención urinaria como motivo del sondaje.
Resultados: Se incluyen 134 sondajes en 113 pacientes, 62 en el grupo sin ecógrafo y 72 en el grupo con ecógrafo. La frecuencia de sondajes por retención se reduce del 47.5% al 21.4% después de introducir el ecógrafo en la unidad. Esto supone una reducción del 50% (RR ajustado= 0.48; IC95%:0.27-0.84, p=0.01) en la frecuencia de sondaje vesical por sospecha de retención urinaria.

Palabras clave: Catéteres de Permanencia; Cateterismo Urinario; Remoción de Dispositivos; Retención Urinaria; Enfermedades de la Vejiga Urinaria; Ultrasonografía; Atención de Enfermería.

INTRODUCTION

A urinary catheter (UC) is a thin, flexible, hollow tube that can be inserted into the bladder either through the urethra (urethra) or through suprapubic access to drain urine. Bladder catheterization (BC) involves the aseptic placement of a flexible catheter of sterile material that allows urine to be drained from the bladder to the outside through the urethra [(1)].

In the United States, between 25% and 32% of patients admitted to hospitals are carriers of a UC, either to control urine output or to resolve urinary retention UR[(2)]. Furthermore, BC is one of the interventions that generates the most morbidity in the healthcare setting, as it is one of the main causes of nosocomial infections[(3)]. It is estimated that around 30% of nosocomial infections are Urinary Tract Infections (UTI), of which 80% are related to urinary catheters[(3)]. The risk of suffering a UTI is tripled in patients carrying a UC [(4)]. These infections lead to an increase in hospital stays, increased expenditure and most importantly: health problems and discomfort in patients [(3)]. It is known that the characteristics of BC influence the occurrence of adverse events related to it, it has been shown that the risk of UTIs in patients with UC increases every day that a BC is in place[(3)] and some studies associate catheter clamping with an increase in the rate of UTIs[(5)].

Apart from infections, BC is associated with other types of adverse events such as urinary tract erosions, bleeding, false pathways, and discomfort [(2,3,5)]. One of the main problems that appear after removing a bladder catheter, and which most frequently leads to its reinsertion, is UR or bladder dysfunction[(6)]. Acute UR is defined as the sudden inability to urinate despite the presence of urine in the bladder and the desire to urinate [(7)]; this situation occurs more frequently in patients who have undergone BC[(6)].

The use of ultrasound to estimate bladder volume has been in the literature since the late 1970s [(8,9)]. Today, vesical volumetric ultrasound is a reliable and valid method, especially for small volumes, and accepted by patients [(10,11)]. It is used in 26% of Critical Care Units in the USA [(12)]. It is a method that is useful in the diagnosis of urinary retention after surgery [(13)], in addition, its use reduces the incidences of UTI[(14)] and according to D'Silva's review suggests that it should be used in patients with suspicion of large post-miction residual volumes[(15)]. The use of portable bladder volumetric ultrasound (PBVU) has, on the other hand, increased the number of successful cases in BC in paediatric patients in the emergency department [(16)]. In our field, it has been studied in surgery patients [(17)] and in neurological patients [(18)]. It is

also a method that has a higher degree of satisfaction among professionals who use it [19].

Nurses play an important role in the insertion and management of UC, so it is essential that their practice reflects the best available evidence, therefore, could the availability of a bladder ultrasound, decrease the frequency of BC due to suspicion of UR?.

The aim of this study is to clarify whether or not it is necessary to have a PBVU device in Internal Medicine hospitalization units.

The main objective of this study is to determine if the availability of a PBVU device used by nurses is related to a decrease in the frequency of BC due to suspicion of UC in adult patients hospitalized in Internal Medicine units.

Secondary objectives:

- To determine if PBVU is associated with a decrease in patient hospital stay.
- To determine if there are other factors that may be associated with a decrease in BC due to suspicion of UR.

METHODOLOGY

Design

A retrospective cohort study was performed, comparing the cohort exposed to the availability of the PBVU device model BladderScan BVI3000 with the one not exposed the year before to the acquisition of said ultrasound device. The study was carried out in the HB1 Internal Medicine ward of the HUFA.

The study population were adult patients undergoing short-term [20] indwelling BC who were admitted to the Internal Medicine ward.

Subject selection and sample size calculation

The calculation was made using statistical software EPIDAT v. 4.1 [21] and considering the most conservative scenario and accepting an alpha risk of 0.05 and a beta risk of 0.2 in a bilateral contrast, a calculation of 124 records was obtained to detect as statistically significant the difference between two proportions, for the exposed group it was expected to be 0.24 and for the unexposed group 0.48. The selection of subjects was carried out by non-probabilistic sampling, the incorporation of patients to the study was done in a chronological consecutive way.

Inclusion criteria

- Records of adult patients of both sexes who required or carried short-term permanent BC [20] (between 1 and 14 days).

- Records of patients who had records on the "Probes and Catheters" form of the Electronic Medical Record (EHR).

Exclusion criteria

- Records of patients who have had long-term permanent UC in the previous 30 days.

- Records of patients with long-term permanent UC (15 days or more) were excluded.

- Records of patients who did not have data of adequate quality in the EHR records.

Data collection

For data collection, the EHR database was consulted. After the data collection was completed, they were tabulated in an anonymised and dissociated database in .xlsx format, which was hosted on the centre's internal server, with limited access to the researchers for later analysis. In this way, patient data remained anonymised, in accordance with the Organic Law 15/1999 of 13 December on the protection of personal data [22].

Study variables

The main dependent variable of the study was "BC for suspicion of UR". In order to determine its presence, the indication of BC was checked in the EHR records. The independent variable was the presence during inpatient stay of the PBVU device. For this purpose, it was verified that the date of admission of the patient was later than 16/03/2016, at which time the PBVU device was made available to the nurses of Internal Medicine ward. The secondary variables to be studied were: urinary tract infection (UTI) acquired up to one month after catheterization, length of hospital stay. Demographic variables sex and age, Clinical variables: Indication of catheterization. To analyse whether the degree of complexity of the patients could influence the outcome, the weight of the AP-DRG of the admission in which the catheterizations took place was compared in both groups, as well as the Charlson comorbidity index[23].

Statistical analysis

The analysis of the data was carried out with the statistical package for the social sciences SPSS v.22. [24] The sample was described by absolute and relative frequencies for the qualitative variables, mean and standard deviation or by median and interquartile range (IQR), in accordance with the distribution of the data, for the quantitative variables. A descriptive analysis was made of the sample obtained and the baseline situation of both groups.

A univariate analysis was performed to study the differences between the two groups with respect to baseline characteristics (age, sex, Charlson index, previous UTI, catheter type and AP-DRG) and with respect to the main variable “catheterization for suspected UR”. In this analysis, tests of χ^2 were used for qualitative variables and to compare quantitative variables between two groups, the t-Student test or non-parametric Mann Whitney's U test was calculated, depending on the distribution of the data. As a main result, it is estimated, by means of modified Poisson regression, the effect of having the PBVU device as a relative risk of catheterization by UR without adjusting and adjusting for other possible related factors. All tests were considered bilateral, statistical significance with a p-value of <0.05 was considered.

Work programme

Once the necessary permissions were obtained from the Research Ethic Committee, a query was made to the HUFA EHR database with the data of the patients who have records from the "Probes and Catheters" form, analysing this form in order to know the percentage of BC that are performed with an indication of "Urinary Retention". The proportions of cases before and after inclusion of the PBVU device were compared.

Funding

This study is the result of another research project that is financed by the funding for research projects of the Alcorcón Foundation University Hospital in its 2015 edition. (15/63 "Clamp or not clamp. Evaluation of its effects on the removal of bladder catheterisation. Controlled clinical trial"). The PBVU device used for this study could be purchased with this funding.

RESULTS

During the study period, a total of 134 catheterizations were recorded in 113 patients. 53% men. Their mean age was 79.2 (SD 11.8). The median length of hospital stay was 14 days (IQR 6-25). The median of lenght of stay after the last catheterization was 7.9 days (IQR 4-17). When comparing the baseline data by groups, we found only statistically significant differences in the AP-DRG, lower in the cohort with available PBVU device. Table 1

Table 1. Baseline situation of both groups.

	Total N=134	No PBVU N=62	PBVU available N=72	Test	p-value
N patients	113	50	63		
Age	79.2 (11.8)	78.8 (12.1)	79.5 (12.8)	*	0.717
Sex (Men)	53%	37 (59.7%)	34(47.2%)	†	0.168
Previous UTI		19 (30.6%)	19 (26.4%)	†	0.701
Previous urological pathology		16(25.8%)	22(30.6%)	†	0.570
Posterior UTI		12(19.4%)	15(20.8%)	†	1.000
Length of stay (days)	14 (6-25)	16 (6-28)	13 (7-24)	‡	0.741
Average Weight AP-DRG		2.2282 (1.65-3.46)	0.9591 (0.7993 -1.7493)	‡	<0.001
Charlson Index		1(1-3)	2(1-3)	‡	0.205

** T-Student*
† χ^2
‡ U de Mann-Whitney

The most frequent indication in the group without PBVU device was suspected UR, with 47.5%; meanwhile, urine output control was the most frequent indication in the group with PBVU, with 45.7% (Table 2).

Table 2. Distribution of BC indication.

Indication	Sin ecógrafo		Con ecógrafo	
Catheter replacement	6	9,8%	5	7,1%
Diuresis control	17	27,9%	32	45,7%
Evacuation	5	8,2%	13	18,6%
Haematuria	2	3,3%		
Urinary incontinence	1	1,6%		
Residual urine measurement			1	1,4%
Surgical protocol			3	4,3%
Urinary Retention	29	47,5%	15	21,4%
Urine Specimen Collection	1	1,6%	1	1,4%
Total	61	100,00%	70	100,00%

The univariate analysis of the association between the presence of bladder ultrasound and the catheterization for suspicion of UR is shown in table 3.

Table 3. Univariate analysis for the presence of bladder ultrasound for urinary retention catheterization.

	Other causes	Suspected UR.	RR-CI95%	Test	p-valuer
No PBVU device	33 (53.2%)	29 (47.5%)	0.45 (0.27-0.76)	χ^2	0.002
PBVU device available	57 (79.2%)	15 (21.4%)			

Other possible factors related to the indication of urinary retention were analyzed and we found that they are older patients, although not statistically significant. We also found that the stay is statistically significant. (Table 4)

Table 4. Univariate analysis for the response variable "BC for suspected UR"

	BC for suspected UR N=44	BC Other causes N=90	Test	p-value
Age	81.6 (10.1)	78 (12.4)	*	0.091
Sex (Men)	25 (56.8%)	46 (51.1%)	†	0.583
Previous UTI	12 (27.3%)	26 (28.9%)	†	1.000
Previous urological pathology	14(31.8%)	24(26.7%)	†	0.546
Posterior UTI	8(19.0%)	19(21.8%)	†	0.819
Length of stay (days)	13 (5.25-21)	15 (7-28)	‡	0.025
AP-DRG Average Weight	1,8885 (0.96-2,27)	1,513850 (0,82-2,52)	‡	0.196
Charlson Index	2(1-3)	2(1-3)	‡	0.661
** T-Student* *† χ^2* *‡ U de mann-Whitney*				

Due to the fact that the groups were not homogeneous in terms of the average weight of the AP-GRD, and that the age was higher in the group of patients in whom a BC was placed for suspected UR, a multivariate analysis was performed using logistic regression to adjust the effect of PBVU availability on the reduction of suspected UR catheterization. Table 5.

Table 5. Multivariate analysis using logistic regression for the variable BC for suspected UR

		RR	CI95% RR		p-value
Non-adjusted estimation	PBVU available	0.45	0.27	0.76	0.003
Multivariate Regression Model	PBVU available	0.48	0.27	0.84	0.01
	Sex (Man)	1.15	0.71	1.86	0.573
	Age	1.02	1	1.05	0.106
	AP-DRG Average Weight	0.99	0.84	1.16	0.863
	Charlson Index	1	0.9	1.12	0.93

DISCUSSION

Our results indicate a notable effect of PBVU device implantation on the reduction of BC due to suspected UR. Numerous studies have evaluated the reliability and accuracy of PBVU, but few quantify the effect of having these devices available [15]. The fact of having such a device means a reduction, in our case of almost 70% of the risk of BC due to suspicion of UR, which follows the line of the results of Frederickson et al. [25] and not only reduces unnecessary catheterization, but also promotes the reduction of unwanted effects of a BC [26,27]. Its efficacy, combined with its validity and acceptance by patients [17] and its impact on reducing costs associated with catheterization [28] make it a non-invasive rather than an effective alternative to BC in suspected UR episodes, or at least allows us to ensure that this catheterization is necessary. It is also observed that as the age of patients increases, their risk of needing a catheterization for suspected UR increases. This risk is almost identical to that reported by Golubovsky et al. [29] and Lee et al. [30]. However, no statistical significance is shown in our regression model. On the other hand, no differences have been found in the incidence of UTI after BC in both groups, since we only have the catheterizations, and not the total number of patients admitted. The results obtained regarding the duration of admission follow the line of previous studies in surgical patients [31,32].

Since this is an observational and retrospective study, the quality of the information collected in the EHR may be lower than in a prospective study. There may also be a limitation due to the fact that the studied population is very heterogeneous, patients with different pathologies are included. Furthermore, it should be noted that we only have the data recorded in the EHR, leaving out those catheterizations not recorded in the EHR for different reasons.

CONCLUSIONS

Therefore, on the basis of the results obtained and the literature consulted, we can say that the presence in internal medicine units of a PBVU device allows a reduction in the

number of BC due to suspicion of UR. It is also observed how, as age increases, the probability of receiving a BC by UR increases. As for hospital stay, we cannot say that it is reduced by the PBVU availability. No other factors were found to be associated with a decrease in bladder catheters due to suspicion of UR.

Ethical and legal aspects

This study has the approval of the Clinical Research Ethics Committee of the HUFA. The proposed research respects the fundamental principles of the Helsinki Declaration. The data protection Organic Law 15/1999, ratified in RD 1720/2007, has been respected, guaranteeing the confidentiality of the information, which was stored anonymously to preserve the anonymity of the patients.

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