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Influence of pre-marking on post-peritoneal dialysis catheter placement complications

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ABSTRACT

Introduction: Good peritoneal access is essential for performing peritoneal dialysis (PD). Our PD unit uses a technique for pre-surgical marking of the peritoneal catheter. The study aimed to evaluate the influence of pre-surgical marking on complications related to post-PD catheter placement.

Materials and Method: This is a cohort study. We included patients over 18 who underwent peritoneal catheter placement in 2018, corresponding to the cohort without marking, and in 2022, corresponding to the cohort with marking. The variables analysed were age, sex, complications, and solutions to complications. Using logistic regression, we calculated the Odds Ratio (OR) of complications for the labelled group and its 95% confidence interval.

Results: 107 patients were analysed. The mean age was 65.6±12.2 years, and 73.8% were male. Of the 56 patients without tagging, 33 suffered complications compared to 18 in the cohort with tagging. OR 0.36 (95% CI 0.16 to 0.79). 38.9% of complications had resolution in the tagging group vs 24.2% in the non-tagging group.

Conclusions: Patients with pre-surgical marking have a 64% lower risk of complications. This effect does not lose magnitude when adjusted for age and sex (OR 0.39 (95% CI 0.17-0.86). Complications in the marked cohort were resolved more frequently than in the unmarked cohort. We conclude that pre-marking the catheter reduces post-surgical complications.

Keywords: preoperative care; postoperative complications; catheters; peritoneal dialysis.

RESUMEN

Influencia del marcaje previo en las complicaciones post colocación del catéter de diálisis peritoneal

Introducción: Un buen acceso peritoneal es imprescindible para la realización de la Diálisis Peritoneal, pudiendo constituir la técnica de marcaje prequirúrgico un punto clave en la aparición de complicaciones.
El objetivo de nuestro estudio fue evaluar la influencia del marcaje pre-quirúrgico en las complicaciones post-colocación del catéter de diálisis peritoneal.

Material y Método: Estudio de cohortes; incluimos a los pacientes mayores de 18 años a quienes se les colocó un catéter peritoneal en 2018 (cohorte sin marcaje) y en 2022 (cohorte con marcaje). Las variables analizadas fueron: edad, sexo, complicaciones y evolución de estas. Realizamos un análisis multivariante mediante regresión logística, calculando la Odds Ratio (OR) y el intervalo de confianza 95% de aparición de complicaciones.

Resultados: Se analizaron 107 pacientes, 73,8% hombres y una edad media de 65,6±12,2 años. De los 56 pacientes sin marcaje, 33 sufrieron complicaciones, frente a 18 de los 51 en la cohorte con marcaje. La OR de complicaciones ajustada

por edad y sexo del grupo marcaje frente a no marcaje fue 0,39, IC 95%:0,17-0,86. El 38,9% de las complicaciones fueron resueltas en el grupo de marcaje frente al 24,2% en el grupo sin marcaje (p=0,548).

Conclusiones: La técnica de marcaje previo del catéter de diálisis peritoneal se asocia a una reducción de las complicaciones postquirúrgicas en estos pacientes.

Palabras Clave: cuidados preoperatorios; complicaciones postquirúrgicas; catéteres; diálisis peritoneal.

INTRODUCTION

Access to the peritoneal cavity is key in the process of peritoneal dialysis and will determine the success of the technique. Correct placement of the peritoneal catheter is of vital importance to ensure a safe and comfortable access for the patient, preventing complications and enabling effective therapy[1-3].

The heterogeneity in patients' body size and abdominal features, including skin folds, scars, and dermatological conditions, underscores the need to individualise catheter placement according to each patient's characteristics and postural variations (supine, sitting)[4]. The generalised practice of using the umbilicus as the sole intraoperative reference may result in excessively deep positioning of the catheter, leading to pressure discomfort and pain at the end of drainage, flow dysfunction, symptoms related to constipation, and urinary retention[1,5,6].

Equally relevant is the choice of catheter exit site, as guidelines of the Spanish Society of Nephrology highlight its importance in reducing infectious complications[7]. The exit site should be accessible for the patient, avoiding areas prone to infection, and the catheter should not be subjected to pressure along the subcutaneous tunnel traversing the abdominal wall[1,5,6,8]. For this reason, the location of the exit site should be evaluated with the patient in the supine, standing, and sitting positions[1]. In our unit, to favour the achievement of successful peritoneal access and in full compliance with recommendations of the International Society for Peritoneal Dialysis (ISPD)[1], prior to surgical implantation of the peritoneal catheter, the nursing staff performs a marking technique of the desired exit site through palpation and identification of anatomical landmarks **(figure 1)**[9].

The marking technique is as follows: with the patient in supine position, using the pubic symphysis as a reference, the catheter coil is placed below it. At the level of the first bead, the site of the surgical incision (paraumbilical area) is marked, and approximately 2–3 fingerbreadths below the 2nd bead, the mark for the catheter exit site is placed. Markings are made bilaterally on both sides of the abdomen. The marking is also

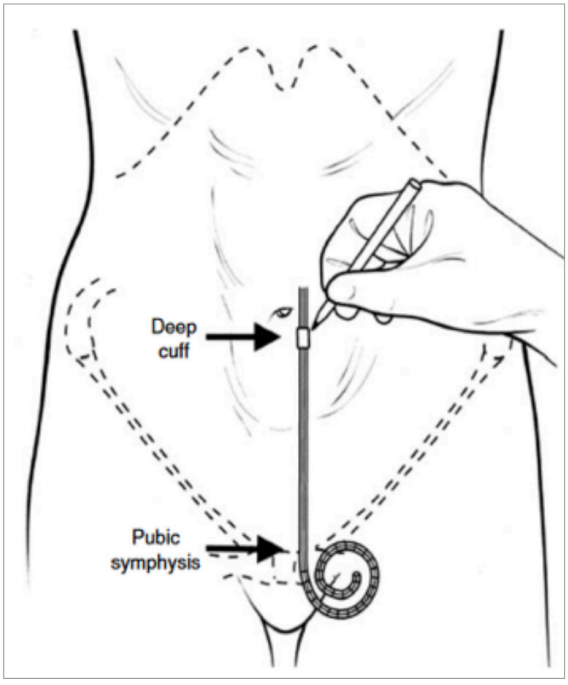

Figure 1. Schematic illustration showing the method used to select the catheter insertion site and deep cuff location in order to achieve proper pelvic positioning of the catheter tip. *Crabtree JH. Selected best demonstrated practices in peritoneal dialysis access. Kidney International Supplements. November 2006; (103): S27–S37. Figure 9, p. S34.*

assessed with the patient sitting and standing, avoiding folds or scars, making sure that the exit site is accessible to the patient,8 making the necessary changes to guarantee correct catheter placement in the operating room, always subject to the surgeon's final decision.

Although studies exist comparing possible complications related to implantation technique[8, 10-12], the current scientific literature does not provide evidence comparing the use of preoperative catheter marking with no marking. For this reason, we considered it appropriate to carry out this study, whose objective was to evaluate the influence of marking on complications after peritoneal dialysis catheter placement.

MATERIALS AND METHODS

This was a historical cohort study conducted at a single centre. We included all patients over 18 years of age who underwent peritoneal catheter placement in 2018 (cohort without marking) and in 2022 (cohort with marking). We excluded patients with abdominal anatomical particularities preventing marking, patients who refused marking, and those in whom catheter placement was performed simultaneously with another surgical procedure. The marking technique employed was as described: in supine position, using the pubic symphysis as reference, the catheter coil was placed below it. At the level of the first bead, the surgical incision site (paraumbilical area)

was marked, and 2–3 fingerbreadths below the second bead, the catheter exit site was marked. Bilateral markings were performed on both sides of the abdomen. The marking was assessed with the patient sitting and standing **(figure 1)**[9]. The implanted catheter was a Swan-Neck (high flow), curved-neck Fresenius® catheter with 2 cuffs and coiled tip. All catheters were implanted by the General Surgery Department of Hospital Universitario Central de Asturias (Asturias, Spain).

Variables analysed included age at time of catheter implantation, sex, catheter placement technique (laparoscopy or laparotomy), complications (catheter displacement, leakage, haematoma, exit site close to surgical wound, intestinal perforation, and seroma), and treatment of complications (alpha manoeuvre, catheter exchange, laparoscopic repositioning, or catheter removal).

Statistical analysis: age was described as mean ± standard deviation. Categorical variables were expressed as absolute and relative frequencies (percentages). Comparisons were drawn using the chi-square exact test. Crude odds ratios (ORs) of complications for the marking group were estimated with 95% confidence intervals (CI) using logistic regression, with complication occurrence as the dependent variable and marking as the independent variable. A multivariate logistic regression model including age and sex as covariates was used to obtain the adjusted OR for complications in the marking group. A p value < 0.05 was considered statistically significant. R statistical software, version 4.3.0 (21-04-2023), was used.

The study fully complied with ethical research principles and Spanish Law 3/2018 of 5 December on Personal Data Protection and Digital Rights Guarantee. Ethical approval was obtained from the Asturias Ethics Committee (Cod CEImPA 14.4.2023).

RESULTS

A total of 107 patients were analysed: 56 patients (52.34%) without catheter marking (2018) and 51 (47.66%) with marking (2022). Of these, 73.8% (n=79) were men, with an overall mean age of 65.6±12.2 years **(table 1)**.

Among the 56 patients without marking, 33 (60%) developed complications, compared with 18 of the 51 (35.3%) in the marking cohort. The OR for complications in the marking group vs the non-marking group was 0.36 (95%CI, 0.16–0.79), corresponding to a 64% lower risk of complications after catheter placement **(figure 2)**.

The effect of marking adjusted for age and sex yielded an OR of 0.38 (95%CI, 0.17–0.83; p=0.02) **(figure 3)**, indicating that, controlling for age and sex, patients with marking had a 62% lower risk of complications following catheter placement.

Among patients with complications, 38.9% were resolved in the marking group vs 24.2% in the non-marking group (p=0.548). The OR for unresolved complications in the marking group was 0.50 (95%CI, 0.14–1.75).

Of the 7 displaced catheters in the marking cohort, 2 (28.6%) were repositioned with alpha manoeuvres, 3 (42.9%) were exchanged, 1 (14.3%) was repositioned laparoscopically, and

Table 1. Characteristics of the 2 cohorts.

Variable	No (n=56)	Yes (n=51)	Total (n=107)	P Value
Sex				
Men	42 (75.0)	37 (72.5)	79 (73.8)	
Women	14 (25.0)	14 (27.5)	28 (26.2)	
Age				
Mean (SD)	64.3 (11.5)	67.0 (12.8)	65.6 (12.2)	
Median [Min; Max]	65.5 [45.0; 85.0]	69.0 [20.0; 88.0]	68.0 [20.0; 88.0]	
Complications				
No	22 (40.0)	33 (64.7)	55 (51.9)	0.0394
Yes	33 (60.0)	18 (35.3)	51 (48.1)	
Types of complications				
No	22 (40.0)	33 (64.7)	55 (51.9)	
Displacement	8 (14.5)	7 (13.7)	15 (14.2)	0.388
Other	8 (14.5)	3 (5.9)	11 (10.4)	
Haematoma	5 (9.1)	1 (2.0)	6 (5.7)	
Exit-site (OS)	2 (3.6)	0 (0.0)	2 (1.9)	
Seroma	10 (18.2)	5 (9.8)	15 (14.2)	
Leakage	0 (0.0)	2 (3.9)	2 (1.9)	

SD: standard deviation; **Min, Max:** minimum, maximum; **OS:** exit site.

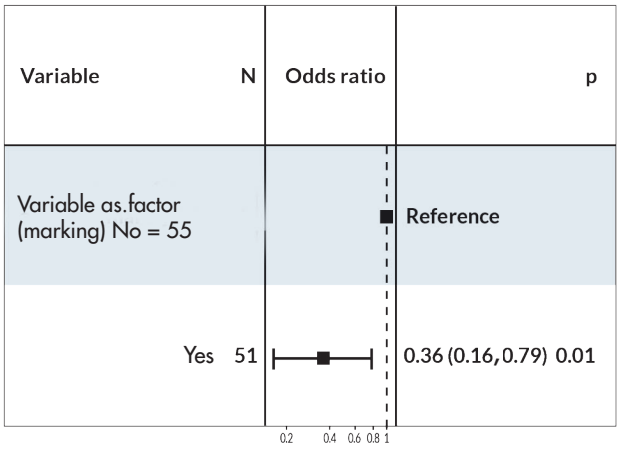

Figure 2. Logistic regression analysis: impact of marking on the occurrence of complications.

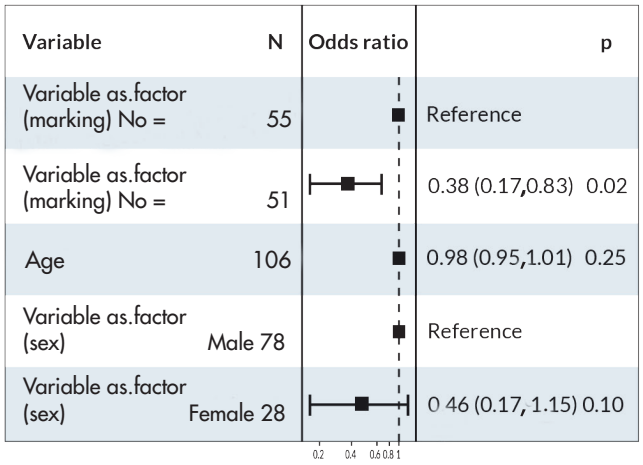

Figure 3. Logistic regression adjusted for age and sex.

1 (14.3%) was removed. Of the 8 displaced catheters in the non-marking cohort, 3 (37.5%) were repositioned with alpha manoeuvres, 3 (37.5%) with bowel movements, and 2 (25%) laparoscopically.

DISCUSSION

Our results show fewer complications in patients with marking: 38.9% vs 24.2%. Patients with marking had an OR of 0.36 (95%CI, 0.16–0.79), corresponding to a 64% lower risk of complications after catheter placement (statistically significant). This effect retained its magnitude when adjusted for age and sex, with an OR of 0.38 (95%CI, 0.17–0.83), also statistically significant.

These findings seem to reinforce ISPD guidelines for creating and maintaining optimal peritoneal dialysis access[1], which recommend the pubic symphysis as a reliable reference for ideal catheter tip placement at the upper part of the true pelvis, avoiding the misleading reference of the umbilicus.

Peppelenbosh et al[11]. considered different implantation techniques and mentioned preoperative marking prior to laparoscopic catheter implantation using the pubic symphysis as a reference, but only assessed exit site location in the supine position. Their work compared complications resulting from surgical techniques employed.

Further research should compare different marking techniques, such as that used by Díaz-Rosales et al.[13], who, for percutaneous peritoneal catheter placement, used the umbilical scar and rectus abdominis borders as references. These authors also noted that marking should be performed preoperatively with the patient standing and clothed to mark belt line positioning.

Wong et al.[14] in a 2014 study, although not aiming to compare catheter placement techniques, demonstrated that up to 30% of patients studied (n=46) did not undergo abdominal wall evaluation or preoperative marking. They reported catheter-related complications in 19 patients (41%), without specifying whether these occurred exclusively in patients without marking or in the total cohort.

A limitation of our work is that we did not analyse surgical techniques (open laparotomy vs laparoscopy), which may have influenced our results. However, the use of laparoscopy was limited in both 2018 and 2022, suggesting minimal effect. Surgeon experience may also affect complication rates; however, surgeons participated in catheter placement in both cohorts, likely reducing this potential confounding effect[12].

Our findings suggest that preoperative peritoneal catheter marking reduces the risk of postoperative complications by 64%. Furthermore, complications were more often resolved in the marking cohort: 38.9% vs 24.2% in the non-marking group. While not statistically significant, this difference is clinically relevant. Altogether, these results highlight the need to implement this simple, low-cost technique to advance towards optimal placement of peritoneal dialysis catheters.

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Conflicts of interest

None declared.

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