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Analysis of nursing practices about the fixation of haemodialysis needles in Spain

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ABSTRACT

Objective: To analyse national haemodialysis nursing practices about the fixation of arteriovenous fistula puncture needles.

Material and Method: Cross-sectional descriptive study, conducted in April-May 2024, using an online questionnaire aimed at haemodialysis nurses throughout Spain. Variables collected: socio-demographics, type of centre, factors related to needle exit, fixation material/techniques and knowledge of recommendations.

Results: 363 nurses participated, 83.5% female, mean age: 44.09±10.7 years, mean experience: 15.18±10.94 years; 72.7% worked in public centres.
According to the respondents, the most influential factors for needle exit were "Patient skin condition" (96.7%) and "Fixation technique" (93.9%); the two least influential were "Having a risk assessment system" (53.4%) and "Type of puncture device" (51%). Chevron and Butterfly fixation techniques were used by 35.4% and 55.1% if we also consider U-Method/H-Method. Paper tape was the most used fixation material (75.3%), with 57.7% thought it the most secure. 66.7% were unaware of published documents with recommendations, and 65.4% did not have protocols covering these aspects in their units. Professionals working in subsidised/private centres have protocols for needle fixation ($p<0.01$), recommendations for patients and professionals ($p<0.01$) and use Butterfly fixation techniques, U-method/H-method ($p<0.01$) in a higher proportion than professionals in public centres.

Conclusions: Accidental needle exit during haemodialysis is an area for improvement. Approximately half of the practitioners use fixation techniques other than those recommended (Butterfly/Chevron/Method-U/Method-H).

Keywords: haemodialysis; arteriovenous fistula; adhesive tape; needle exit; nursing care; patient safety.

RESUMEN

Análisis de las prácticas enfermeras en relación a la fijación de las agujas de hemodiálisis en España

Objetivo: Analizar las prácticas enfermeras en hemodiálisis, a nivel nacional, en relación a la fijación de las agujas de punción de las fístulas arteriovenosas.

Material y Método: Estudio descriptivo transversal, realizado en abril-mayo 2024, mediante cuestionario online, dirigido a enfermeras de hemodiálisis de toda España.
Variables recogidas: sociodemográficas, tipo de centro, factores relacionados con la salida de agujas, material/técnicas de fijación y conocimiento sobre recomendaciones.

Resultados: Participaron 363 enfermeras, 83,5% mujeres, edad media: 44,09±10,7años, experiencia media: 15,18±10,94 años; un 72,7% trabajaban en centros públicos.

Según los encuestados, los factores que más influyen en la salida de agujas son "Estado del paciente"(96,7%) y "Técnica de fijación"(93,9%); siendo los menos influyentes "Tener un Sistema de evaluación del riesgo"(53,4%) y "Tipo de dispositivo de punción"(51%).
El 35,4% empleaban técnicas de fijación Chevron y Mariposa; siendo un 55,1% si consideramos también Método-U/Método-H.
El material de fijación más utilizado fue el esparadrapo de papel (75,3%), considerándolo un 57,7 % como el más seguro.
El 66,7% desconocían la existencia de documentos publicados con recomendaciones y un 65,4% no disponían en sus unidades de protocolos que recogieran estos aspectos.
Los profesionales que trabajan en centros concertados/privados disponen de protocolos para fijación de agujas($p<0,01$), recomendaciones para pacientes y profesionales($p<0,01$) y utilizan técnicas de fijación Mariposa, Método-U/Método-H ($p<0,01$) en mayor proporción que los profesionales de los centros públicos.

Conclusión: La salida accidental de las agujas durante la hemodiálisis constituye un área de mejora. Aproximadamente la mitad de los profesionales utilizan técnicas de fijación diferentes a las recomendadas (Mariposa/Chevron/Método-U/Método-H).

Palabras clave: hemodiálisis; fístula arteriovenosa; esparadrapo; salida de agujas; atención de enfermería; seguridad del paciente.

INTRODUCTION

Chronic kidney disease (CKD) represents an important public health problem, with the number of affected individuals increasing every year[1]. According to the latest data published by the Spanish Renal Registry (2022), 55.4% of people receiving renal replacement therapy had a kidney transplant, 39.8% were on hemodialysis (HD), and 4.8% on peritoneal dialysis, with hemodialysis being the most widely used dialysis therapy[2].

Vascular access is a key element for performing HD, and the arteriovenous fistula (AVF) is the vascular access of choice when compared with the central venous catheter, because it presents fewer complications and a higher survival rate[3]. In the case of an AVF, treatment is carried out by accessing the bloodstream through cannulation with needles, and securing these devices is essential to prevent accidental dislodgement and ensure patient safety.

Accidental dislodgement of AVF needles during the HD session is a very infrequent situation, but it can be severe and lead to hemorrhagic shock within a very short time due to massive blood loss, as blood flow rates between 300–500 mL/min are used during HD[4-6]. According to the literature, several situations may increase the risk of accidental needle dislodgement during HD[7-9]: patient condition (confusion, restlessness, agitation, cognitive impairment, dementia, semi-consciousness), patients who refuse to keep the access and bloodlines visible, difficult cannulation of the vascular access, the condition of the patient's skin, lack of observation by staff, or failure to replace tape with a new one each time needles are repositioned.

Other causes that may contribute to accidental needle dislodgement include insufficient adhesion of tape to the skin, poor-quality adhesive, traction on bloodlines, and unexpected movement of the AVF arm.[9-11].

Working groups and/or scientific societies such as the Spanish Multidisciplinary Group for Vascular Access (GEMAV), the Spanish Society of Nephrology Nursing (SEDEN), the American Nephrology Nurses Association (ANNA), as well as other international authors, propose a number of recommendations regarding HD needle fixation[4,9,11]. These include: the use of effective needle-fixation techniques; securing the bloodlines to the patient's arm while always keeping the vascular access and bloodlines visible during treatment; and, as patient-safety measures, close monitoring of disoriented patients and the use of blood-leak sensors[12-13]. Among the most effective needle-fixation techniques, the Chevron and Butterfly methods stand out as the safest and most resistant to traction, although the Uy H method is also recommended[4,9,11].

In routine practice, different techniques are used to secure HD needles, varying across centers and professionals, with some variations of the techniques shown in **table 1**[10,11].

Needle fixation and securing the bloodlines during the HD session are essential practices to prevent accidental needle dislodgement[11], although the best recommended techniques are not always applied, and protocols are not always available to professionals, particularly for inexperienced staff[10].

Understanding the usual practices performed by nurses in different centers regarding AVF needle fixation, as well as the measures implemented to prevent accidental needle dislodgement, will allow us to identify variability in clinical practice and determine potential areas for improvement.

The general objective of the present study was to analyze nursing practices nationwide related to the fixation of AVF needles during hemodialysis.

The specific objectives were:

- To describe the materials and techniques used by nurses for HD needle fixation.
- To assess nurses' experience regarding accidental AVF needle dislodgement during HD sessions.
- To analyze HD nurses' perceptions of the existence of specific recommendations regarding prevention of accidental AVF needle dislodgement, as well as the existence of procedures in their units.

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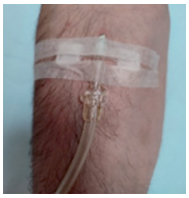
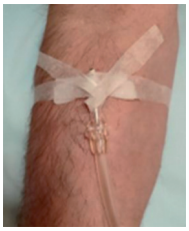
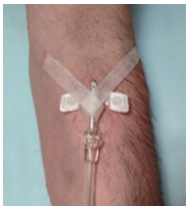
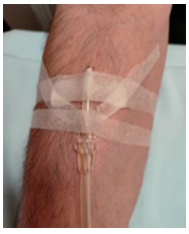
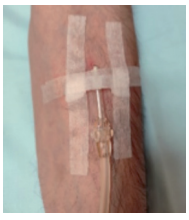
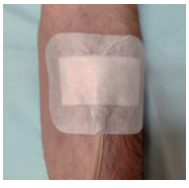
Table 1. Description of the most commonly used hemodialysis needle fixation techniques

TECHNIQUE	IMAGE	PROCEDIMIENTO
OVERLAPPED STRIPS		1º Place a strip of tape horizontally over the wings, without covering the puncture site. 2º Reinforce with another horizontal strip further down.
CHEVRON		1º Place a strip of tape horizontally over the wings, without covering the puncture site. 2º Place another strip of tape under the needle tubing, with the adhesive side facing up. 3º Cross the tape over the wings, securing them to the skin, without covering the puncture site.
BUTTERFLY		1º Place a strip of tape under the needle tubing, with the adhesive side facing up. 2º Cross the tape over the wings, securing them to the skin, without covering the puncture site.
U METHOD		1º Place a strip of tape under the needle tubing with the adhesive side facing up. 2º Place the tape over the wings, securing them to the skin so that the tape forms a "U" shape. 3º Place a strip of tape horizontally over the wings, without covering the puncture site. 4º Reinforce with another horizontal strip further down.
H METHOD		1º Place a strip of tape horizontally over the wings, without covering the puncture site. 2º Place a strip of tape vertically over each wing, forming an "H."
DRESSING		1º Apply the dressing to secure the wings and fix part of the needle tubing.

MATERIAL AND METHOD

Design: Descriptive cross-sectional study conducted between April and May 2024.

Population and sample: Nurses from HD units throughout Spain, including public and private/contracted centers. All bedside nurses working in HD units nationwide who could complete an online questionnaire were included; all individuals who did not agree to voluntary participation were excluded. A non-probabilistic convenience sampling method was used. Sample size was estimated using GRANMO version 8.0.

Since there is no registry in Spain indicating the number of nurses working in dialysis, we estimated the sample size assuming an infinite population.

To achieve an 8% precision in estimating a proportion with a two-sided 95% normal asymptotic confidence interval, assuming that 50% of nurses used at least one of the recommended needle-fixation techniques in consensus documents (Chevron/Butterfly/H method/U method)[9-11], and considering an expected dropout rate of 20%, it was necessary to recruit 189 professionals.

Variables

All variables were collected via a self-administered online questionnaire. The questionnaire had three parts: the first gathered sociodemographic data and previous experience concerning accidental HD needle dislodgement; the second asked about fixation techniques and materials used for AVF needles; and the third collected information on other nursing practices to prevent accidental needle dislodgement.

Sociodemographic variables: age, sex, type of workplace, years of hemodialysis experience, and autonomous community.

Additional variables included: having witnessed accidental needle dislodgement; its frequency; which needle dislodges most often; perception of needle dislodgement as a life-threatening event; factors associated with needle dislodgement; materials used for fixation; materials considered safest; existence of protocols/procedures for needle fixation; fixation technique used; knowledge of fixation technique names; knowledge of scientific-society guidelines and consensus documents; use of wingless needles and perceived risk; existence of informational documents for professionals/patients; knowledge and use of moisture-blood leak detection devices.

Data collection

Data were collected between April and May 2024 using a 25-item online questionnaire with multiple-choice responses, previously piloted in 10 HD nurses to ensure clarity. Distribution

was carried out through SEDEN via email, explaining the study and inviting participation. A survey link was sent, and nurses were encouraged to forward it to other HD nurses, including non-members, to increase participation and representativeness. It was also disseminated through other forums and working groups.

Data analysis

Data collected via the online questionnaire were stored in an anonymized database and analyzed using SPSS v27.

A descriptive statistical analysis was performed: qualitative variables with frequencies and percentages, quantitative variables with median and interquartile range (IQR). Bivariate analysis was conducted: Chi-square and Fisher's test for qualitative variables. Normality was assessed using Kolmogorov-Smirnov. Hypothesis testing for qualitative and quantitative variables employed non-parametric Mann-Whitney U and Kruskal-Wallis tests.

A p value ≤0.05 was considered significant.

Aspectos éticos

Participation was anonymous and voluntary, with participants providing informed consent.

The study received approval from the Research Ethics Committee of Hospital Universitario Fundación Alcorcón (Code 24/32).

The project complied with Organic Law 3/2018 on Personal Data Protection and the EU Regulation (GDPR) 2016/679.

RESULTADOS

A total of 363 nurses from 17 autonomous communities and 1 autonomous city responded; 72.7% (n=264) worked in public centers. The mean age was 45 years (IQR: 47, min 22, max 69), with a mean experience of 10 years (IQR: 40, min 0, max 40). Women represented 83.5% (n=303).

A total of 90.1% (n=327) had witnessed accidental needle dislodgement, although 73.8% (n=268) reported that this occurred twice or fewer per year. Most (98.3%, n=357) considered this situation to be or potentially to be life-threatening.

Regarding the needle most likely to dislodge, 44.4% (n=161) answered that both equally, 38% (n=138) the venous needle, and 17.6% (n=64) the arterial needle.

Factors perceived as most influential (Quite+Very) in needle dislodgement were "Patient condition" (96.7%) and "Fixation technique" (93.9%); the least influential (None+A little) were "Having a needle-dislodgement risk assessment system" (53.4%) and "Type of cannulation device used" (51%) (see **table 2**).

Figure 1 shows the fixation techniques used: 36.3% (n=131) used Chevron and Butterfly techniques, increasing to 55.1% (n=200) when including U and H methods.

Table 2. Main reasons for accidental needle dislodgement during hemodialysis from the professionals' perspective.

	None n (%)	Some n (%)	Quite a lot n (%)	A lot n (%)
Patient condition (movement, agitation, confusion…).	1 (0.3%)	21 (5.8%)	125 (34.4%)	226 (62.3%)
Technique used for needle fixation.	1 (0.3%)	21 (5.8%)	174 (47.9%)	167 (46%)
Type of cannulation device (e.g., winged needles, fistula-catheter Abbocath-type…).	29 (8%)	156 (43%)	135 (37.2%)	43 (11.8%)
Patient's skin condition (dry skin, sweating, dermatitis…).	13 (3.6%)	101 (28.8%)	167 (46%)	82 (22.6%)
Material used for fixation: fabric tape, paper tape, other dressing types.	3 (0.8%)	69 (19%)	164 (45.2%)	127 (35%)
Completely covering puncture site with sheets, blankets…	13 (4.4%)	72 (19.8%)	148 (40.8%)	127 (35%)
Bloodline-fixation technique.	4 (1,1%)	49 (13.5%)	182 (50.1%)	128 (35.3%)
Having a system to identify patients at higher risk of needle dislodgement.	40 (11%)	154 (42.4%)	129 (35.5%)	40 (11%)
Using new tape each time needles are repositioned.	31 (8.5%)	85 (23.4%)	130 (35.8%)	117 (32.2%)
Skin completely dry for fixation (after disinfection).	15 (4.1%)	46 (12.7%)	149 (41%)	153 (42.1%)

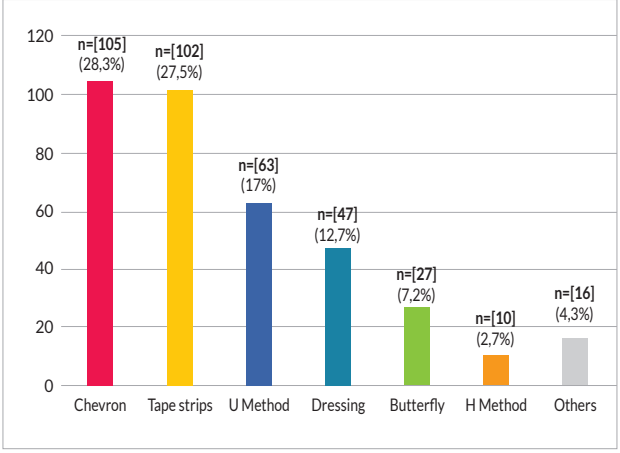


Figure 1. Hemodialysis needle fixation techniques used by professionals*.

* A single professional may have indicated using more than one needle-fixation technique regularly.

The most frequently used fixation material was paper tape (75.3%), and 57.7% considered it the safest **(table 3)**.

A total of 63.6% (n=231) believed that using wingless needles poses a higher risk of accidental dislodgement, although 56.7% (n=206) had never used them.

Most respondents (66.7%, n=242) were unaware of published documents providing recommendations for needle fixation; 64.5% (n=234) lacked unit protocols addressing these issues, and 62.3% (n=226) indicated that their units lacked professional- or patient-directed documents with information on minimizing accidental needle dislodgement during HD.

Regarding knowledge and use of moisture-blood leak detectors, 86.2% (n=313) were unfamiliar with these devices and 96.4% (n=350) did not use them.

Table 3. Description of materials used for HD needle fixation and professionals' opinions on safety.

Needle Fixation Material n (%)	Most commonly used by professionals n (%)	Safest material according to professionals n (%)
Paper tape	280 (77.9%)	212 (58.4%)
Hypoallergenic tape	116 (31.9%)	92 (25.3%)
Gauze adhesive	58 (15.9%)	44 (12.1%)
Fabric tape	46 (12.9%)	68 (18.7%)
Transparent adhesive	31 (8.5%)	55 (15.1%)
Silk tape	21 (6.1%)	32 (8.8%)
Silicone tape	16 (4.4%)	25 (6.9%)
Others	14 (3.8%)	13 (3.6%)

No differences were found when comparing professional age according to fixation technique (p=0.977) or fixation material (p=0.171), nor when comparing experience according to fixation technique (p=0.643) or fixation material (p=0.439).

Knowledge and use of moisture-leak detectors were not related to age (p=0.908; p=0.106) or experience (p=0.115; p=0.247).

When grouping professionals by type of center, those working in private/contracted centers more frequently had protocols for needle fixation (p<0.01), patient/professional information documents (p<0.01), and used Chevron, Butterfly, U, and H techniques (p<0.01) than those in public centers **(table 4)**.

Table 4. Comparison of needle-fixation technique and existence of protocols and/or informational materials according to type of workplace.

		Public center n (%)	Private center n (%)	p value
Use of Chevron Butterfly / U Method / H Method	YES NO	127 (48.5%) 135 (51.5%)	73 (73.7%) 26 (26.3%)	p=0.000*
Existence of protocols	YES NO	68 (26.1%) 195 (73.9%)	60 (60.6%) 39 (39.4%)	p=0.000*
Existence of informational material for staff/patients	YES NO	78 (29.5%) 186 (70.5%)	59 (59.6%) 40 (40.4%)	p=0.000*

DISCUSSION

This study analyzes hemodialysis nurses' practices in Spain regarding AVF needle fixation.

Most participants considered accidental needle dislodgement a serious, albeit infrequent, complication. These findings are consistent with the ANNA survey, in which more than 75% of respondents had witnessed needle dislodgement and more than 50% were (very often/often/occasionally) concerned about blood loss[14].

We did not find studies addressing whether venous or arterial needles dislodge more frequently; most documents refer to "needle dislodgement" without specifying which[10-11]. Although one might expect the venous needle—subjected to higher positive pressure—to carry a higher extrusion risk, respondents most frequently reported that both dislodge equally.

Fixation technique was identified as one of the main factors favoring accidental needle dislodgement. Only one-third used one of the recommended techniques (Chevron or Butterfly), cited as the safest and most resistant[9-10]; however, when including the U and H methods—also recommended

by ANNA[11]—this proportion increased to just over half. These findings are consistent with Parisotto et al., who in an international study of 171 dialysis units in Europe, the Middle East, and Africa, found that more than 50% used a technique other than Chevron, Butterfly, or U[15].

Lack of awareness of published recommendations, the absence of unit protocols, and the lack of informational materials for patients and professionals represent areas for improvement to unify clinical practice and enhance patient safety. Variability in clinical practice has been described for decades; in the 1970s, authors such as Wennberg and Gittelsohn[16] highlighted this issue, attempting to identify factors explaining variation in care. Several studies since then underline gaps in knowledge of best practices, uncertainty due to the nature of evidence, and the lack of standardization programs within institutions[17-18].

Nurses in private/contracted centers were more likely to have protocols and informational materials and more frequently used recommended fixation techniques. Public centers typically develop protocols for the individual center only, whereas private chains or multinational dialysis companies produce and disseminate materials across multiple centers, increasing reach and uptake.

Patient condition was considered the most influential factor in needle dislodgement. The literature warns that mental, cognitive, and neurological impairment is a major risk factor for accidental needle dislodgement in HD[11,19-20]. and recommends evaluating this risk in all patients[7,11,19-20]. However, half of respondents did not consider having a patient-risk identification system to be influential. The European Dialysis and Transplant Nurses Association/ European Renal Care Association (EDTNA/ERCA) has developed an online system to report accidental needle dislodgement incidents (https://vnd.edtnaerca.org/report)[21] and recommends identifying high-risk patients based on: restlessness, dementia, confusion, hypotension, cramps; skin condition (excess hair, sweating); difficult access; and patients who keep their access covered.

Poor skin condition is also described as a risk factor for needle dislodgement[11], yet it was not identified as highly influential by respondents. HD is a chronic treatment involving repeated adhesive use in a limited skin area. These materials may cause adhesive-related skin injuries, affecting needle security. Many authors show that chronic adhesive use endangers the skin and recommend correct selection of fixation materials and appropriate adhesive removal techniques, as they can significantly impact safety and quality of life[22-26].

Paper tape was the most frequently used material, followed by hypoallergenic tape, both considered safe. Some professionals used the terms interchangeably. The latest SEDEN manual[9] mentions hypoallergenic tape for HD needle fixation; meanwhile, studies by Chan et al.[10] and the ANNA Workgroup[11] used paper tape to test traction resistance of fixation techniques. Due to lack of evidence on material selection—and considering that skin condition is a risk factor[11] and HD patients are more susceptible to skin alterations—this topic deserves further study.

Most nurses were unaware of moisture-leak detectors, and very few had used them. Although the literature recommends these devices—especially for high-risk patients—because they provide early alerts[11], their use is limited due to high cost[27].

This study has limitations. A national, open, voluntary online survey cannot guarantee participant representativeness. However, participation exceeded 350 nurses, and sociodemographic characteristics (age, sex) aligned with the Spanish nursing population[28].

Based on the results, accidental needle dislodgement during HD sessions remains an area for improvement among Spanish HD nurses.

Although rare, blood loss is a major concern and may constitute a life-threatening emergency.

Almost half of the professionals use fixation techniques other than the recommended ones (Chevron, Butterfly, U, H), and there is a lack of awareness of published recommendations to prevent accidental needle dislodgement.

Development of protocols and availability of informational materials for patients and professionals represent key areas for improvement, especially in public centers.

Conflicts of interest

None declared.

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