

ORIGINAL ARTICLE

Prevalence of difficult venous access and associated risk factors in highly complex hospitalised patients

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Aims and objectives. To estimate the prevalence of difficult venous access in complex patients with multimorbidity and to identify associated risk factors.

Background. In highly complex patients, factors like ageing, the need for frequent use of irritant medication and multiple venous catheterisations to complete treatment could contribute to exhaustion of venous access.

Design. A cross-sectional study was conducted.

Methods. 'Highly complex' patients ($n = 135$) were recruited from March 2013–November 2013. The main study variable was the prevalence of difficult venous access, assessed using one of the following criteria: (1) a history of difficulties obtaining venous access based on more than two attempts to insert an intravenous line and (2) no visible or palpable veins. Other factors potentially associated with the risk of difficult access were also measured (age, gender and chronic illnesses). Univariate analysis was performed for each potential risk factor. Factors with $p < 0.2$ were then included in multivariable logistic regression analysis. Odds ratios were also calculated.

Results. The prevalence of difficult venous access was 59.3%. The univariate logistic regression analysis indicated that gender, a history of vascular access complications and osteoarticular disease were significantly associated with difficult venous access. The multivariable logistic regression showed that only gender was an independent risk factor and the odds ratios was 2.85.

Conclusions. The prevalence of difficult venous access is high in this population. Gender (female) is the only independent risk factor associated with this. Previous

What does this paper contribute to the wider global clinical community?

- The number of high complex patients needing intravenous therapy is increasing. To identify risk factors of poor venous access is essential to provide an optimal care.
- The prevalence of difficult venous access in complex patients is 59.3%. Significant risk factors include being female and a history of complications related to vascular access.
- It is defined a population whose venous capital is difficult to preserve. It is highlighted the need for a proactive and expert intervention of ITTs in this population.

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history of several attempts at catheter insertion is an important criterion in the assessment of difficult venous access.

Relevance to clinical practice. The prevalence of difficult venous access in complex patients is 59.3%. Significant risk factors include being female and a history of complications related to vascular access.

Key words: comorbidity, fluid therapy, inpatients, peripheral catheterisation, vascular access devices

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Introduction

Highly complex patients are patients of advanced age, with comorbidities and severe functional limitations, and are considered of high risk in relation to mortality and health-care use (Ollero Baturone *et al.* 2002, Jadad *et al.* 2010, Health, Social Services and Equality Ministry of Spain 2012).

In the Basque Country (Spain), the population of highly complex patients requiring case management are a mean of 75 years old and have a mean of 1.9 hospital admissions per year, higher values than the mean across Europe (Health, Social Services and Equality Ministry of Spain 2012). Overall, they represent 5% of patients but account for more than 40% of hospital bed days (Garcia-Morillo *et al.* 2005) and 85% of the admissions of these patients are directly related to their multimorbidity (Garcia-Morillo *et al.* 2005). The cost of care associated with these patients is sixfold higher than that for patients with a single chronic condition (Garcia-Morillo *et al.* 2005).

When hospitalised, an increasing number of highly complex patients require intravenous therapy as a safe way to administer treatment (Ingram & Lavery 2005). The rate of complications in patients receiving intravenous therapy ranges between 10–25% (Hawes 2007, Gallieni *et al.* 2008). These complications include infiltration and extravasation with an incidence of 34% (Dougherty 2008), phlebitis with an incidence of 20% (Nassaji-Zavareh & Ghorbani 2007) and others such as thrombophlebitis, pneumothorax, haemothorax, infections, thrombosis and catheter-related bacteraemia (Royal College of Nursing IV Therapy Forum 2005). In the case of highly complex patients with multimorbidities, the situation is complicated by the process of ageing itself, as well as the need for frequent use of agents that are irritant to veins and for multiple venous catheters to complete treatments, which contribute to greater limitations and exhaustion of venous access (Hawes 2007).

Background

The difficulty of venous access is determined by whether there is a lack of visible and palpable veins together with a history of difficulty in placing venous catheters (Brannam *et al.* 2004, Jacobson & Winslow 2005, Hawes 2007, Lapoltole *et al.* 2007, Sebbane *et al.* 2013, Fields *et al.* 2014, Chiricolo *et al.* 2015). In highly complex patients, difficult venous access may lead to serious consequences at various different levels. Patient pain and overall suffering are increased by repeated attempts to obtain venous access, which in many cases lead to the insertion of catheters in inappropriate locations such as flexion areas (hand, wrist and antecubital fossa) or lower limbs, in turn increasing the risk of subsequent complications (Royal College of Nursing IV Therapy Forum 2005, Hawes 2007, Cicolini *et al.* 2009, Infusion Nurses Society 2011, Abolfotouh *et al.* 2014). Difficult access also leads to delays in the administration of medication, partial or total loss of the prescribed dose, and the need to place central venous lines, representing a greater risk for patients (Hawes 2007). It also causes an increase in the use of materials, nurse time (Hawes 2007), costs associated with complications and length of hospital stay.

The current need to improve the management of difficult venous access, especially in this type of patient, has seen the emergence of intravenous therapy teams (ITTs) (Royer 2001, Hornsby *et al.* 2005, Kokotis 2005). These are mainly composed of nurses specialised in intravenous therapy and management of venous access and have been shown to improve outcomes in clinical practice (Mezey & Scholder 2003, Burns & Lamberth 2010, Centers for Disease Control and Prevention 2011), reducing the iatrogenic risks associated with intravenous therapy, and increasing patient safety and well-being (Caballero 2006), as well as being more cost-effective (Kokotis 2005).

As we have found no studies in the literature identifying the key factors that influence vascular deterioration of highly complex patients, we have designed the following study to estimate the prevalence of difficult venous access

in highly complex hospitalised patients and identify associated risk factors.

Methods

Design

To address the objective, we designed a cross-sectional study.

Participants

The target population included people who were classified as highly complex patients with multiple comorbidities (multimorbidity), based on the Kaiser Permanente pyramid.

The Kaiser pyramid model is a theoretical approach to stratify population according to their care needs. It was developed in the United States and has been extended to other countries.

In 2013, The Department of Health and Consumer Affairs of the Government of the Basque Country used this model to identify and stratify population with different health needs, from promotion and prevention to highly complex needs (Fig. 1).

The study inclusion criteria were being admitted to hospital during the study period and being on the list of patients classified as highly complex.

The exclusion criteria were being in another level of the pyramid, unable to give informed consent form or treated previously by an ITT.

Candidate patients were identified by case management or liaison nurses of the participating hospitals, who were informed in writing whenever a patient classified as highly complex required hospital care. In turn, these nurses reported the hospital admission to the research team, and within 48 hours, a member of team in each participating

centre visited the patient. After informing the patient about the study, informed consent was requested and we started to assess the study variables.

To detect a rate of 60% of difficult venous access, with an accuracy of 7% and an alpha error of 0.05, the sample size required was estimated to be 133 patients. Given the cross-sectional nature of the study and that the difficulty of venous access was assessed after patient recruitment, we did not believe it to be necessary to consider potential losses.

Data collection

The main study variable was the presence of 'difficult venous access', based on whether patients met one or both of the following criteria: (1) a personal history of difficult venous access, based on patient report or a record of more than two attempts to insert an intravenous line, and (2) no visible or palpable veins appearing on either arm after placing a tourniquet.

The other variables were a series of factors that might predispose highly complex patients to difficult venous access. For this purpose, data were collected on a wide range of items (Table 1).

The Barthel Index was used to measure the 'level of independence' (see Fig. 2). We considered scores <20 as total dependence, 20–40 as severe dependence, 45–55 moderate dependence and 60 or more as low dependence.

For the factor 'number of chronic diseases', we considered a cut-off point (median).

We considered some potentially aggressive intravenous treatments such as anticoagulants, immunosuppressants, corticoids and chemotherapy.

The factor 'limited limb function' refers to limitations due to hemiplegia, breast surgery or burns.

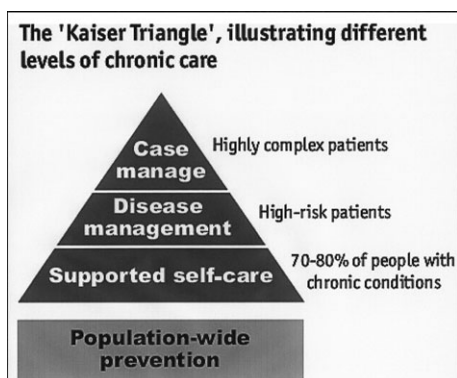


Figure 1 The Kaiser Triangle, illustrating different levels of chronic care. Source: NHS and University of Birmingham.

Table 1 Potential risk factors for difficult venous access

Age and gender
Number of hospital admissions in the year before the study
Level of independence (Barthel Index)
Chronic illnesses: number and diagnoses
History of treatment with anticoagulants, immunosuppressants, corticoids or chemotherapy
Previous major surgery
Limited limb function
Peripheral venous disease
Toxic habits
History of multiple attempts to place catheters for intravenous therapy
History of complications associated with vascular access: phlebitis, thrombosis, haematomas, infiltrations and extravasations, among others
Body mass index

Activity	Score
THE BARTHEL INDEX	
	Patient Name: _____
	Rater Name: _____
	Date: _____
FEEDING	
0 = unable	
5 = needs help cutting, spreading butter, etc., or requires modified diet	
10 = independent	_____
BATHING	
0 = dependent	
5 = independent (or in shower)	_____
GROOMING	
0 = needs to help with personal care	
5 = independent face/hair/teeth/shaving (implements provided)	_____
DRESSING	
0 = dependent	
5 = needs help but can do about half unaided	
10 = independent (including buttons, zips, laces, etc.)	_____
BOWELS	
0 = incontinent (or needs to be given enemas)	
5 = occasional accident	
10 = continent	_____
BLADDER	
0 = incontinent, or catheterized and unable to manage alone	
5 = occasional accident	
10 = continent	_____
TOILET USE	
0 = dependent	
5 = needs some help, but can do something alone	
10 = independent (on and off, dressing, wiping)	_____
TRANSFERS (BED TO CHAIR AND BACK)	
0 = unable, no sitting balance	
5 = major help (one or two people, physical), can sit	
10 = minor help (verbal or physical)	
15 = independent	_____
MOBILITY (ON LEVEL SURFACES)	
0 = immobile or < 50 yards	
5 = wheelchair independent, including corners, > 50 yards	
10 = walks with help of one person (verbal or physical) > 50 yards	
15 = independent (but may use any aid; for example, stick) > 50 yards	_____
STAIRS	
0 = unable	
5 = needs help (verbal, physical, carrying aid)	
10 = independent	_____
TOTAL (0-100): _____	

Source: Internet Stroke Center-www.strokecenter.org

Figure 2 Barthel Index to measure the ‘level of independence’.

The ‘toxic habits’ factor refers to the previous history of parenteral drug habit.

To measure the item ‘History of multiple attempts to place catheters for intravenous therapy’, we established three ranges: <10, between 10–20 and more than 20 punctures in the year before the study. For the analysis, we estimate that patients who have received more than 10 punctures have suffered damage to the venous access, considering this a risk factor.

Regarding body mass index (BMI), 30 was established as the cut-off point for severe obesity, which was hypothesised as having greater difficulty for venous access.

All the data were recorded in field notebooks. Prior to this, we trained all members of the research team in the

collection of data on the study variables. Subsequently, the data were entered into a dedicated Microsoft Access database for the statistical analysis.

The study was carried out between 1 March–21 November 2013 in OSI Araba University Hospital in the city of Vitoria-Gasteiz (500 beds) and Alto Deba Hospital in the municipality of Arrasate-Mondragón (95 beds), both public hospitals in the network of the Basque Health Service.

Ethical approval

All patients gave written informed consent prior to their inclusion in the study. They were told about the potential benefits and risks associated with their participation. The

anonymity of participants was safeguarded in accordance with the Spanish Organic Law 15/1999 of 13 December, on the Protection of Personal Data, and the principles of the Declaration of Helsinki. The study was approved by the Ethics Committee of the OSI Araba University Hospital (reference number 2013-007) and was included on the hospital insurance policy.

Data analysis

For the descriptive analysis, frequencies and percentages were calculated for qualitative variables. For the continuous variables, means and standard deviations or medians, interquartile range, minimum and maximum were calculated depending of the normality of the variable.

Means were compared using the Student's *t*-test, and medians were compared using the nonparametric Mann–Whitney *U*-test.

Binary logistic regression was used for the univariate analysis, to explore the association between each of the risk factors and difficult venous access. Means were compared using the nonparametric Mann–Whitney *U*-test, given that the data did not meet the normality assumptions. All factors with a $p < 0.2$ in this univariate analysis were included in a multivariable logistic regression model. Odds ratios were calculated to describe the probability of having difficult venous access. The level of significance was set at 0.05 for all the tests. Data were analysed using the SPSS® version 21.0 (International Business Machines Corporation (IBM), Armonk, New York, USA).

Results

We recruited 135 patients, of whom more than half (65.2%) were women.

The general characteristics of the sample are the following ones:

The mean age was 78.4 years (SD 9.4), the youngest patient was 49 years old, and the oldest one was 99.

The median of hospitalisations in the year before the study was 1 (IQR 0–2) with a maximum number of 11 hospitalisations. In addition, length of hospital stay had a median of six days (IQR 4–9), the minimum was 1 and the maximum 39.

Regarding catheterisation, venous access was considered difficult in 59.3% of the sample (95% CI 50.8–67.9), in all cases on the basis that they had a personal history of more than two attempts to insert an intravenous line (though some patients also recalled past difficulties obtaining venous access and/or lacked visible or palpable veins).

In relation to risk factors, the median Barthel Index of the total sample was 90 points (IQR 60–100) and the minimum and maximum were 0 and 100, respectively.

The median of chronic diseases was 3 (IQR 3–4) with minimum of 1 and maximum of 6. According to this result, this median was established as the cut-off point for univariate analysis. The most common were cardiovascular diseases and respiratory conditions, diagnosed in 94.8 and 67.4% of participants, respectively. Other chronic illnesses included diabetes (48.9%), osteoarticular disease (28.9%) and obesity (13.3%).

Regarding previous treatments, 77% of participants had been on anticoagulants and 54.1% corticosteroids. The prevalence of other factors was as follows: 12.6% for previous major surgery, 14.8% for limited limb function, 36.3% for peripheral venous disease and 14.8% for toxic habits. The year prior to the start of the study, 44.5% of the patients had undergone more than 10 attempts to obtain venous access, 43% had developed haematoma associated with needle punctures, 11.9% had developed phlebitis, and 11.9% had had infiltration.

The characteristics of the sample in relation to difficult and not difficult venous access can be seen in Tables 2 and 3.

The univariate analysis of the association between these potential risk factors and difficult venous access indicated that gender ($p = 0.01$), a history of complications related to intravenous therapy ($p = 0.034$) and osteoarticular disease ($p = 0.025$) were statistically significant. Among the other variables, only obesity was found to be close to significance (Tables 2 and 3).

The following factors were included in the multivariable logistic regression analysis: cardiovascular disease ($p = 0.112$), cancer ($p = 0.09$), previous major surgery ($p = 0.132$), level of independence ($p = 0.172$), the presence of haematomas ($p = 0.103$), and obesity ($p = 0.062$), as well as the aforementioned factors found to be statistically significant in the univariate analysis. The multivariable analysis showed that only gender ($p = 0.008$) was a significant independent risk factor. The odds ratio for this factor was 2.85 (95% CI 1.31–6.25).

Discussion

In the literature, we have not found any studies similar to ours in a sample of highly complex patients. However, in other populations, prospective studies have been carried out assessing the difficulty of venous access by counting the number of attempts to insert an intravenous line and these have identified factors that may have an influence on success (Brannam *et al.* 2004, Jacobson & Winslow

Table 2 Univariate logistic regression analysis for difficult venous access risk factors

Variable category	Difficult venous access			
	N (%)	<i>p</i>	Odds ratio	95% CI
Gender <i>n</i> (%)				
Female (<i>n</i> = 47)	35 (74.5)	0.010	2.79	1.28–6.07
Male (<i>n</i> = 88)	45 (51.1)			
Chronic illnesses (≥4 conditions) <i>n</i> (%)				
Yes (<i>n</i> = 50)	32 (64.0)	0.391	1.37	0.67–2.81
No (<i>n</i> = 85)	48 (56.5)			
Cardiovascular disease <i>n</i> (%)				
Yes (<i>n</i> = 128)	78 (60.9)	0.112	3.90	0.73–20.88
No (<i>n</i> = 7)	2 (28.6)			
Chronic respiratory disease <i>n</i> (%)				
Yes (<i>n</i> = 91)	51 (56.0)	0.276	0.66	0.32–1.39
No (<i>n</i> = 44)	29 (65.9)			
Chronic kidney failure <i>n</i> (%)				
Yes (<i>n</i> = 27)	16 (59.3)	0.999	1.00	0.42–2.36
No (<i>n</i> = 108)	64 (59.3)			
Diabetes <i>n</i> (%)				
Yes (<i>n</i> = 66)	41 (62.1)	0.508	1.26	0.63–2.51
No (<i>n</i> = 69)	39 (56.5)			
Obesity (body mass index >30 kg/m ²) <i>n</i> (%)				
≥30 (<i>n</i> = 39)	28 (71.8)	0.062	2.15	0.96–4.82
<30 (<i>n</i> = 96)	52 (54.2)			
Osteoarticular disease <i>n</i> (%)				
Yes (<i>n</i> = 39)	29 (74.4)	0.025	2.56	1.12–5.83
No (<i>n</i> = 96)	51 (53.1)			
History of treatment with: anticoagulants, immunosuppressants, corticoids or chemotherapy <i>n</i> (%)				
Yes (<i>n</i> = 119)	72 (60.5)	0.424	1.53	0.54–4.36
No (<i>n</i> = 16)	8 (50.0)			
Previous major surgery <i>n</i> (%)				
Yes (<i>n</i> = 17)	13 (76.5)	0.132	2.47	0.76–8.04
No (<i>n</i> = 118)	67 (56.8)			
Limited limb function (any limb) <i>n</i> (%)				
Yes (<i>n</i> = 20)	14 (70.0)	0.294	1.73	0.62–4.83
No (<i>n</i> = 115)	66 (57.4)			
Peripheral venous disease <i>n</i> (%)				
Yes (<i>n</i> = 49)	30 (61.2)	0.726	1.14	0.56–2.33
No (<i>n</i> = 86)	50 (58.1)			
Toxic habits <i>n</i> (%)				
Yes (<i>n</i> = 20)	11 (55.0)	0.675	0.82	0.31–2.12
No (<i>n</i> = 115)	69 (60.0)			
History of >10 venipuncture attempts <i>n</i> (%)				
Yes (<i>n</i> = 60)	38 (63.3)	0.441	1.32	0.66–2.65
No (<i>n</i> = 74)	42 (56.8)			
History of vascular access-related complications <i>n</i> (%)				
Yes (<i>n</i> = 64)	44 (68.8)	0.034	2.14	1.06–4.33
No (<i>n</i> = 71)	36 (50.7)			
Haematomas <i>n</i> (%)				
Yes (<i>n</i> = 58)	39 (67.2)	0.103	1.80	0.888–3.658
No (<i>n</i> = 77)	41 (53.2)			
Cancer <i>n</i> (%)				
Yes (<i>n</i> = 25)	11 (44.0)	0.090	2.14	0.89–5.15
No (<i>n</i> = 110)	69 (62.7)			

2005, Lapostolle *et al.* 2007, Bensghir *et al.* 2012, Sebbane *et al.* 2013, Fields *et al.* 2014, Chiricolo *et al.* 2015). Some of these studies assessed the difficulty of venous access based on a physical examination and characteristics of the veins (Jacobson & Winslow 2005, Sebbane *et al.* 2013), while others considered venipuncture attempts prior to the current hospitalisation and the presence of chronic conditions (Fields *et al.* 2014, Chiricolo *et al.* 2015). The results of our study show a high prevalence of difficult venous access in highly complex patients, notably higher than the rates observed in studies focused on other population groups (Lapostolle *et al.* 2007, Fields *et al.* 2014). In classifying our patients as having difficult access, the factor with the greatest weight was a history of more than two attempts to insert an intravenous line, the presence of visible or palpable veins being less important.

Our findings indicate that when venous access is required in patients, although a physical examination is essential, we should also consider patient history of catheterisation to predict the difficulty of venous access. In fact, Fields *et al.* (2014) noted that, although it may not be easy to assess this history, it may be a better predictive factor than the condition of the patient at the time.

Regarding associated factors, being female was found to be significantly associated with difficult venous access. Among the women, there was a greater prevalence of difficult access and a threefold higher risk of difficult access than in the men. Some previous research has linked being female to higher rates of phlebitis (Tagalakis *et al.* 2002, Forni *et al.* 2010, Dychter *et al.* 2012) and fewer successful attempts to place intravenous devices in peripheral blood vessels (Jacobson & Winslow 2005). Further, women tend to be more affected by osteoarticular disease, and in our study, this disease was found to be significantly associated with the risk of difficult venous access.

On the other hand, age was not statistically significant. This is consistent with the results of the Jacobson and the Bensghir study, which assessed variables associated with

Table 3 Comparison of continuous variables between both groups

Variable	DVA	Not DVA	<i>p</i>
Number of hospitalisations in the previous year	1 (0–2)	1 (0–2)	0.219*
Barthel Index	85 (55–100)	90 (70–100)	0.155*
Age	79.1 (9.0)	77.9 (9.6)	0.487†

*Mann–Whitney *U*-test.

†Student's *t*-test.

intravenous catheter insertion failure in peripheral veins (Jacobson & Winslow 2005, Bensghir *et al.* 2012). However, age may be clinically relevant, given that older individuals have undergone anatomical changes typical of ageing and tend to have a weaker vascular system (Wengström & Margulies 2008, Dychter *et al.* 2012). Various authors have clearly advocated a proactive effort to avoid damage to vessels in this group of patients (Kokotis 2005, Dychter *et al.* 2012).

Chronic illnesses do not seem to be associated with the difficulty of venous access, except in the case of osteoarticular disease. In contrast, some studies assessing the difficulty of inserting intravenous devices in a peripheral vein have considered chronicity to be a potential risk factor for difficult venous access, but without specifying the number or type of conditions (Brannam *et al.* 2004, Kokotis 2005, Costantino *et al.* 2010). Chronicity has also been associated with a greater risk of phlebitis (Tagalakakis *et al.* 2002). Further, the Lapostolle study found a significant association with diabetes, but this condition was evaluated together with other factors such as chemotherapy and recurrent hospital admission (Lapostolle *et al.* 2007), making it difficult to assess which of them was directly related to the difficulty of venous access. Fields *et al.* (2014) indicated that diabetes may be associated with difficult access due to the frequent medical attention these patients require or morphological changes in their veins.

Several studies have analysed obesity in other populations (Brannam *et al.* 2004, Hawes 2007, Costantino *et al.* 2010, Dargin *et al.* 2010, Bensghir *et al.* 2012, Dychter *et al.* 2012, Sebbane *et al.* 2013, Fields *et al.* 2014), with similar results to ours; namely, this variable was not found to be significantly associated with difficult access (Jacobson & Winslow 2005, Lapostolle *et al.* 2007, Fields *et al.* 2014). However, its clinical relevance should be assessed given that the associated increase in subcutaneous tissue makes it more difficult to find veins in the arms (Fields *et al.* 2014, Frank 2016).

A history of treatment with anticoagulants or corticosteroids is relevant in the patient anamnesis as a real or potential indicator of multiple venipuncture procedures, given that patients treated with these drugs often require long and repeated intravenous therapy and hence multiple insertions of intravenous catheters (Fields *et al.* 2014).

The number of previous placements of intravenous devices has been considered a risk factor as well as used in defining difficult venous access in other studies (Hawes 2007, Lapostolle *et al.* 2007, Fields *et al.* 2014, Chiricolo

et al. 2015). Unlike in these previous studies, however, we have quantified the number of intravenous placements retrospectively, finding a high percentage of patients had undergone multiple venipunctures. Therefore, we consider it essential to include this variable in the assessment of the patient. Likewise, it is essential to collect data on the history of complications related to vascular access, as we demonstrate in this study. According to the literature, the most common complications are infiltration and phlebitis (Tagalakakis *et al.* 2002, Nassaji-Zavareh & Ghorbani 2007, Dougherty 2008, Dychter *et al.* 2012, Frank 2016), and perhaps, the presence of haematomas should be added to this list, given the high prevalence of this factor in our study.

Limitations

One of the limitations of the study was that the number of venous punctures was quantified by interviewing the patient, with the potential for memory bias. Although we reviewed patient medical records to minimise this bias, we found that the number of attempts to place a catheter is not usually recorded. Another factor that may have had an impact on this issue was that we did not assess the experience/skills of the nurses carrying out these procedures. Fields underlines that it is difficult to collect data assessing the experience of the health professional involved retrospectively, but it should nevertheless be taken into account (Fields *et al.* 2014). Success in placing intravenous devices has been measured prospectively in other studies (Hornsby *et al.* 2005, Jacobson & Winslow 2005), with nurses with greater experience requiring fewer attempts (Jacobson & Winslow 2005). Accordingly, future research should address this issue to provide further evidence.

The sampling was not random and a major disadvantage of this is seasonal variability if the recruitment period is short. In our study, this was addressed by recruiting over a relatively long period, including months with higher and lower rates of hospital admission of complex patients. Lastly, another potential source of bias is interviewer bias, this being minimised in our study by training researchers and the use of the same data collection tools.

Conclusion

To conclude, we found a high prevalence of difficult venous access, especially among women, and it was generally related to a history of more than two attempts to insert an intravenous line, rather than to veins not being visible or

palpable. The risk of difficult venous access was associated with being female, osteoarticular disease and a history of complications related to vascular access.

A strength of this study was that it assesses the difficulty of venous access proactively, combining physical examination and an analysis of the patient's history regarding vascular access, and considers a wide range of variables. It is also pioneering in that it considers difficult vascular access specifically in complex patients.

The results may have implications for clinical practice, as they describe a population group in which it is difficult to preserve venous access. They highlight the need for proactive intervention by ITTs in this population, to ensure the adequate placement of intravenous devices and minimise the number of venipunctures.

Further research is required focusing on what are the most important risk factors for difficult venous access and thereby extending the findings of our study. In addition, similar analysis could be performed in groups at other levels of the Kaiser pyramid. On the other hand, it would be interesting to explore the impact of ITTs on the management of venous access devices in complex patients.

Relevance to clinical practice

The number of highly complex patients needing intravenous therapy is increasing. Identifying risk factors for poor venous access is essential to providing optimal care.

The prevalence of difficult venous access in complex patients is 59.3%. Significant risk factors include being

female and a history of complications related to vascular access.

A population whose venous access is difficult to preserve is defined, and the need for a proactive and expert intervention of ITTs in this population is highlighted.

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Contributions

All authors have contributed similarly to the preparation of this manuscript.

Conflict of interest

The authors have no conflicts of interest to declare in relation to this work.

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