Artigos Originais

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Permanent vascular access in patients with end-stage renal disease, Brazil

Acesso vascular permanente em pacientes renais crônicos terminais no Brasil

ABSTRACT

OBJECTIVE: To assess factors associated with the establishment of permanent vascular access for patients with end-stage renal disease.

METHODS: Cross-sectional study conducted in a nationally representative sample of Brazilian end-stage renal disease patients in dialysis and transplant centers during 2007. The sample comprised only patients who received hemodialysis as a primary therapy modality and reported the type of vascular access for their primary hemodialysis treatment (N=2,276). Data were from the TRS Project – "Economic and Epidemiologic Evaluation of Modalities of Renal Replacement Therapy in Brazil". Multiple logistic regression analysis was used to assess factors associated with the establishment of permanent vascular access in these patients.

RESULTS: About 30% of the patients studied had an arteriovenous vascular access. The following factors were associated with a lower likelihood of having an arteriovenous vascular access as a primary type of access: time of hemodialysis start since the diagnosis of chronic renal failure ≤ 1 year; shorter dialysis therapy; having no private health insurance; living in the central-western, northeastern and southeastern regions of Brazil; and living in the northern region plus having no private health insurance. In the final model there was found a positive association between the outcome and pre-dialysis care and no were association with socioeconomic and comorbidity variables.

CONCLUSIONS: The study results showed that the focus should on pre-dialysis care to increase the establishment of an arteriovenous vascular access before starting hemodialysis in Brazil.

DESCRIPTORS: Arteriovenous Fistula. Health Services Accessibility. Renal Dialysis, instrumentation. Renal Insufficiency, Chronic. Cross-Sectional Studies.

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RESUMO

OBJETIVO: Analisar fatores associados à provisão de acesso vascular arteriovenoso no Brasil.

MÉTODOS: Estudo transversal, nacionalmente representativo, com pacientes com doença renal crônica terminal acompanhados em serviços de diálise ou em centros transplantadores no ano de 2007. A amostra incluiu apenas pacientes que tiveram a hemodiálise como primeira modalidade de tratamento e que sabiam com que tipo de acesso vascular haviam iniciado o tratamento (N = 2.276). Os dados são oriundos do Projeto TRS – "Avaliação econômico-epidemiológica das modalidades de Terapia Renal Substitutiva no Brasil". Regressão logística múltipla foi utilizada .

RESULTADOS: Aproximadamente 30% dos pacientes tinham acesso vascular arteriovenoso. Os fatores associados à baixa probabilidade de ter acesso vascular arteriovenoso como primeiro tipo de acesso foram: tempo de diagnóstico de doença renal crônica anterior à entrada em hemodiálise ≤ 1 ano, menor tempo de tratamento dialítico, não possuir cobertura de plano de saúde, residir na região Centro-Oeste, Nordeste e Sudeste, e residir na região Norte e ao mesmo tempo não possuir cobertura de plano de saúde. No modelo final não foi observada associação do desfecho com variáveis socioeconômicas e comorbidades, mas sim com cuidados pré-diálise.

CONCLUSÕES: Os resultados mostram que, para aumentar a provisão de acesso vascular arteriovenoso antes do início da hemodiálise no Brasil, os esforços devem ser focados no cuidado pré-diálise.

DESCRITORES: Fístula Arteriovenosa. Acesso aos Serviços de Saúde. Diálise Renal, instrumentação. Insuficiência Renal Crônica. Estudos Transversais.

INTRODUCTION

The establishment of an arteriovenous vascular access before hemodialysis is the ideal option to treat patients with end-stage renal disease (ESRD)[5] as it is associated with better metabolic control and more favorable clinical outcomes.[8] The vascular access should be created in patients within three to six months of an anticipated need for dialysis[a] and it has been considered an adequate pre-dialysis care measure.[8,14] A permanent vascular access for hemodialysis (HD) includes an autologous arteriovenous fistula (AVF) or alternatively an arteriovenous graft when suitable veins are not available.[3,a] The establishment of an access requires attempts and preparation for the surgical procedure that may take weeks or even months before the actual cannulation process.[2] In emergencies, a temporary central venous catheter (CVC) allows rapid access for HD.[3,a] However, it has higher risk of complications such as infection and thrombosis.[1,10,13] In addition, temporary CVC provides a lower blood flow rate,[11] thus limiting the effectiveness of HD.[a]

In Brazil dialysis centers of the *Sistema Único de Saúde* (SUS – National Public Health System) have a protocol of establishing an arteriovenous vascular access as early care.[b] However, according to data from the Brazilian Society of Nephrology in 2008, 66% of the patients who started HD using catheters had their treatment started without previous preparation by health providers. And patients later referred to a nephrologist are also likely to start dialysis using a temporary catheter.[19] There has been no national study to assess factors associated with the establishment of permanent vascular access in Brazil. This study aimed to assess factors associated with this procedure in ESRD patients.

METHODS

The present study is part of a large cross-sectional study, the "TRS Project – Economic and Epidemiologic Evaluation of Modalities of Renal Replacement Therapy in Brazil," conducted by the Universidade

[a] National Kidney Foundation. 2006 Updates clinical practice guidelines and recommendations. New York;2006 [cited 2009 Aug]. Available from: http://www.kidney.org/professionals/kdoqi/pdf/12-50-0210_JAG_DCP_Guidelines-VA_Oct06_SectionC_ofC.pdf

[b] Ministério da Saúde. Portaria nº 432 de 6 de junho de 2006. [cited 2009 Oct]. *Diario Oficial Uniao*. 7 jun 2006; Seção 1.

Federal de Minas Gerais Health Economics Research Group from January to May 2007.

Patients were recruited from 81 dialysis and 17 transplant centers accredited by the Brazilian Nephrology Society whose main databases were available to the public health sector. The sample was representative of the national Brazilian population. A total of 3,036 patients who had undergone renal replacement therapy were interviewed using structured questionnaires by previously trained interviewers. Information on socio-economic and demographic characteristics as well as on quality of life was collected. The patients' satisfaction level was also assessed. All patients selected were 18 years old or more diagnosed with ESRD and were either on dialysis for at least three months or were at least six months post-kidney transplant. Patients who had multiple transplants were excluded from the study. A stratified two-stage cluster sample was applied and sampling units were: renal replacement therapy services and patients. Only patients who had HD as a primary dialysis modality were enrolled (2,276 subjects) in the present study. The statistical power of the sample was 99.9%.

Hypothesis testing to compare proportions and error probability was applied to verify the sample power before the study. The prevalence of arteriovenous fistula used in this formula was described in international studies.[14]

The response variable was the primary type of vascular access used for hemodialysis in each patient (arteriovenous vascular access including arteriovenous fistula and arteriovenous graft; or temporary CVC). The explanatory variables included age, gender, income, education level, skin color, city, region of residence, private health insurance coverage and clinical variables (time of HD start since the diagnosis of chronic renal failure [CRF] and presence of diabetes mellitus and hypertension before HD). All variables with "do not know" answers were considered as having "missing" information.

The descriptive analysis included measure of frequency distribution and central tendency. The association between response and explanatory variables was assessed by univariate logistic regression and those variables with $p \leq 0.20$ were included in the multiple model. The odds ratio (OR) was used to assess power analysis and its related 95% confidence interval (95% CI).

The relevance of each variable included in the multiple model was verified by the Wald test, and those variable with no significant contribution were removed. The adjustment of the final model was verified by comparing it with other similar models through the likelihood-ratio test, as well as by the Hosmer-Lemeshow goodness-of-fit test. The final model included variables with $p \leq 0.05$. The interaction between the variables in the final model was also tested. Thus, based on the algorithm, the

probability of occurrence was estimated. The analyses were performed using the software R version 2.7.2.

The study was approved by the Research Ethics Committee of the Universidade Federal de Minas Gerais in 2004 (ETIC 0397/04). All subjects and renal replacement therapy centers were asked to sign a consent form prior to their participation in the study.

RESULTS

Among the 2,276 patients studied, 1,466 were on HD therapy at the time of the interview, 351 were on peritoneal dialysis and 459 had kidney transplantation. Their mean age was 49 years (SD = 14.4). The average monthly income, reported by 2,205 patients, was US$ 400.5 (SD = US$ 680.9), approximately 2.4 times the monthly minimum wage in Brazil at the time. The mean duration of dialysis therapy reported by 2,173 patients was 4.88 years (SD = 4.47) (Table 1).

Of the patients studied, 31% had arteriovenous vascular access for HD as a primary access, while 69% had temporary CVC. The univariate analysis showed lower rates of permanent vascular access associated with younger age; education level ≤ 11 years; low income; dark skin color; living in capital cities; and living in any region other than southern Brazil. Having no private health insurance, absence of diabetes or hypertension before diagnosis, time of HD start since the diagnosis of CRF ≤ 1 year and shorter dialysis therapy were also associated factors (Table 2).

Four factors were associated with low establishment of permanent vascular access in the multiple logistic regression: time of HD start since the diagnosis of CRF ≤ 1 year; shorter dialysis therapy; having no private health insurance; and living in the northeastern, central-western or southeastern regions.

A multiplicative interaction between having no private health insurance and the region of residence was identified. Thus, the final model included the following variables: time of HD start since the diagnosis of CRF ≤ 1 year; shorter dialysis therapy; having no private health insurance; living in the northeastern, central-western or southeastern regions and living in the northern region combined with having no private health insurance (Table 3). The Hosmer-Lemeshow test result was 0.347.

Those patients diagnosed with CRF one year before starting HD were 3.4 times more likely to start therapy with a temporary CVC. The increment of one year of treatment increased the likelihood of having an arteriovenous vascular access. Having no private health insurance increased that likelihood of starting therapy with a temporary vascular access to almost 1.56. Patients living in the southeastern, central-western and northeastern regions were 1.6, 2.6 and 2.9 more

Table 1. Characteristics of patients on hemodialysis as primary modality of renal replacement therapy. Brazil, 2007.

Variable	n	%
Socioeconomic and demographic		
Gender		
Male	1,281	56.3
Female	995	43.7
Skin color[a]		
Black	295	12.9
White	965	42.4
Asian	71	3.1
Mixed	765	33.6
Indigenous	41	1.8
Other	113	5.0
Do not know	26	1.1
Education level[a]		
Illiterate	137	6.0
≤ 4 years of formal education	711	31.2
≤ 8 years of formal education	615	27.0
≤ 11 years of formal education	571	25.1
> 11 years of formal education	238	10.5
Do not know	4	0.2
Private health insurance[a]		
No	1,552	68.2
Yes	720	31.7
Do not know	4	0.2
City of residence		
Capital	865	38.0
Interior	1,411	62.0
Region of residence		
Southeastern	1,060	46.6
Central-western	180	7.9
Northeastern	354	15.6
Northern	114	5.0
Southern	567	24.9
Clinical conditions		
Diabetes[a]		
Yes	538	23.7
No	1,732	76.1
Do not know	6	0.3
Hypertension[a]		0.1
Yes	1,937	85
No	337	14.8
Do not know	2	0.1
Primary type of vascular access[a]		
Arteriovenous vascular access	704	30.9
Temporary central venous catheter	1,568	68.9
Do not know	4	0.2

To be continued

Table 1 continuation

Variable	n	%
Time before HD start since diagnosis of CRF[a]		
≤ 1 year	1,387	60.9
> 1 year	730	32.1
Do not know	159	7.0

CRF: chronic renal failure; HD: hemodialysis.
[a] "missing" variables

likely to use a temporary CVC as a primary access for HD, respectively. Those patients living in the northern region who did not have private health insurance were 4.3 times more likely to start treatment with a temporary vascular access.

DISCUSSION

There were identified five socioeconomic and clinical factors associated with lower likelihood of arteriovenous vascular access as primary type of access for HD in Brazil: time of HD start since the diagnosis of CRF ≤ 1 year; shorter dialysis therapy; having no private health insurance; living in the northeastern, central-western or southeastern regions; and living in the northern region and having no private health insurance. Stehman-Breen et al[21] (2000) reported that 35% of the patients selected from dialysis centers in the US had permanent access at the beginning of therapy, and those who had been informed about their illness earlier were more likely to have permanent access at the beginning of HD therapy. This reflects proper pre-dialysis care.[4] An early diagnosis of chronic renal disease allows enough time to the patient to accept a vascular access and to prepare it, as well as to detect and correct any inadequacy in the maturation process. Pre-dialysis care includes not only care provided by a nephrologist, but also patient education by other health providers.

Although the effect of early care provided by nephrologists was not investigated in our study, Stehman-Breen et al[21] study also showed that more visits to the nephrologist before starting HD increased the likelihood of establishing a permanent access prior to therapy. In United States, Arora et al[4] (1999) and Astor et al[5] (2001) concluded that a delayed referral of patients to a nephrologist negatively affected the establishment of permanent vascular access in primary HD. This finding points out the importance of nephrologist care.

Arora et al[4] (1999) also found that a substantial number of patients seen earlier by nephrologists still had catheters at the beginning of treatment. It suggests that adequate preparation of patients with ESRD requires referral to a nephrologist at an even earlier time point in the course of chronic renal disease, and requires a

Table 2. Univariate logistic regression of the use of temporary central venous catheter as primary access including other factors. Brazil, 2007.

Variable	Arteriovenous vascular access (%)	OR	95%CI	p-value
Age* (years)		0.989	0.983;0.996	0.001
Gender				
Male	31.1	0.986	0.824;0.180	0.877
Female	30.8			
Education level*				
≤ 11 years of formal education	30.1	1.712	1.301;2.255	0.000
> 11 years of formal education	42.3			
Income* (US$)		1.000	1.000;1.000	0.002
Skin color*				
Black	25.1	1.394	1.054;1.845	0.02
Non-black	31.8			
City of residence*				
Capital	28.5	1.204	1.000;1.448	0.045
Interior	32.5			
Region of residence*				
Southeastern	31.8	1.484	1.201;1.834	0.000
Central-western	25.6	2.017	1.387;2.934	0.000
Northeastern	16.6	3.534	2.547;4.904	0.000
Northern	27.2	1.854	1.188;2.894	0.007
Southern	40.9			
Private health insurance*				
No	27.1	1.761	1.461;2.123	0.000
Yes	39.4			
Diabetes mellitus*				
Yes	34.2	0.830	0.675;1.019	0.076
No	30			
Hypertension*				
Yes	31.5	0.841	0.651;1.087	0.186
No	27.9			
Time before HD start since diagnosis of CRF*				
≤ 1 year	21.1	3.523	2.900;4.279	0.000
> 1 year	48.3			
Duration of dialysis (years) therapy*		0.950	0.932;0.969	0.000

OR: odds ratio of temporary central venous catheter vs. arteriovenous vascular access; CI: confidence interval; CRF: chronic renal failure; HD: hemodialysis.
* p≤0.20 (Wald test)

multidisciplinary team for pre-dialysis care (generalists, nurses and providers), not only nephrologists.

Patients with health insurance coverage were more likely to have an arteriovenous vascular access before primary HD. This finding may be explained by the fact that private health service include outpatient access[7] and regular medical visits.[12] According to Mendoza-Sassi & Béria,[12] (2003) Brazilian patients with private insurance coverage were 80% more likely to have regular medical attention.

Ribeiro et al[17] (2006) found that SUS users seek more medical care in emergency services and suggested that these units are the first to provide care to these patients. For patients with ESRD, it is not ideal. Ongoing care is necessary and should promote early referral of patients to establish a permanent vascular access before hemodialysis.

The duration of dialysis therapy was associated with the establishment of an arteriovenous vascular access in the present study. It is possible that patients starting

Table 3. Logistic regression, including interaction, associating use of temporary central venous catheter as primary access to predictor variables. Brazil, 2007.

Factor	OR	95%CI
Time before HD start since diagnosis of CRF ≤ 1 year*	3.432	2.804;4.208
Duration of dialysis therapy*	0.940	0.929;0.962
Having no private health insurance*	1.555	1.052;2.302
Region of residence		
Southeastern*	1.543	1.037;2.999
Central-Western*	2.593	1.340;5.206
Northeastern*	2.864	1.607;5.225
Northern*	0.725	0.361;1.463
Living in the Southeastern region x having no private health insurance	0.893	0.546;1.458
Living in the Central-western region x having no private health insurance	0.604	0.259;1.389
Living in the Northeastern region x having no private health insurance	1.162	0.549;2.447
Living in the Northern region x having no private health insurance*	4.293	1.535;12.854

OR: odds ratio of temporary central venous catheter vs. arteriovenous vascular access; CI: confidence interval; CRF: chronic renal failure; HD: hemodialysis.
* $p \leq 0.05$ (t-test for coefficients)

treatment at different time points are subject to different care practices or have access to different services. Also, changes in the epidemiological profile of patients such as aging, higher rates of diabetes and cardiovascular diseases, can occur over time and offset the improvements in patient care.[9]

The region of residence also influenced the likelihood of establishing permanent vascular access for HD. One possible explanation for regional differences is greater concentration of medical doctors, particularly specialists, in certain regions. For example, 80% of nephrologists have their practices in the southeastern and southern regions.[11] This discrepancy in the distribution of medical doctors may be attributed to different economic development of Brazilian regions and more availability of medical residence and better working and employment conditions in these regions.[15]

However, in the present investigation, it is not clear why patients from the southeastern region had less permanent access as compared to those in the southern region. Ribeiro et al[17] (2006) found that patients from the southern region are more likely to use SUS services than those from southeastern Brazil.

Differences in the provision of dialysis and preparation of vascular access were reported throughout the UK,[6] but they could not be entirely explained based on age and/or ethnic groups, thereby suggesting the influence of other factors such as service capacity and/or practice standard.[6] Although almost half of HD services in Brazil are located in the southeastern region,[20] it seems that they are not sufficiently effective. Travassos et al[22] (2006) found a lower utilization of public health services in the northern, northeastern and central-western than in the southeastern region.

Regional differences in the establishment of vascular access associated with not having private health insurance can be explained by differences in the proportion of patients who have private health insurance within each region. The multiplicative interaction of the variables having no private health insurance and region of residence showed a better fitting model. Patients living in the northern region who did not have private insurance were significantly less likely to start HD with permanent vascular access. Ribeiro et al[17] (2006) have previously reported this gap in the proportion of SUS users with and without private health insurance in each region: 21:1 and 15:1 in the northeastern and northern regions, respectively.

The present study has some limitations. First, its cross-sectional design does not allow any causal inference. The findings should be interpreted as associations since exposure and outcome occurred simultaneously. A prevalence bias may have occurred due to selection into or out of the study population: patients who were not successful in getting primary permanent vascular access or died before HD start were less likely to participate in the study. In addition, the variables were self-reported and thus subject to recall bias. However, the dichotomization of the variables skin color and time of HD start since the diagnosis and the inclusion of duration of dialysis therapy may have reduced the chance of error. Other important variables such as time of referral to a nephrologist and potential problems while establishing an arteriovenous vascular access were not investigated.

Variables usually associated with permanent vascular access,[1,16] such as dark skin color, age, income, education level and presence of comorbidities including

diabetes mellitus and hypertension, were not statistically significant in the multiple analysis. In the final model, the factors associated with failure to establish an arteriovenous vascular access for all ESRD patients were mainly related to pre-dialysis care. Therefore, given the increasing number of patients on HD in Brazil,[20] it is important to implement a care program to

ESRD patients that includes establishing an adequate arteriovenous access prior to HD, which in turn may be cost-effective and ultimately improve these patients' quality of life.[18,23] Further investigations are needed to explore the characteristics of dialysis services that may influence establishing a permanent vascular access for HD.

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