
Physical examination of arteriovenous fistula: The influence of professional experience in the detection of complications

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Abstract

Vascular access is one of the leading causes of mobilization of financial resources in health systems for people with chronic kidney disease on hemodialysis. Physical examination of the arteriovenous fistula (AVF) has demonstrated its effectiveness in identifying complications. We decided to evaluate the influence of nurses' professional experience in the detection of complications of the AVF (venous stenosis and steal syndrome). The study took place in eight hemodialysis centers between May and September of 2011 in the north of Portugal. Sample was constituted by registered nurses. The nurses involved in the experiment were divided in two groups: those who had more than 5 years of experience and those who had less than 5 years of experience. Ninety-two nurses participated in the study: 34 nurses had less than 5 years of professional experience and 58 had more than 5 years of professional experience. In the practices considered by nurses in the detection of venous stenosis, there were no differences observed between the groups ($P > 0.05$). In steal syndrome, there were no differences observed between the groups in the practices of the nurses in the detection of this complication of the AVF ($P > 0.05$). We concluded that professional experience does not influence the detection of venous stenosis and steal syndrome.

Key words: Nursing care, renal dialysis, arteriovenous fistula, physical examination

INTRODUCTION

The end stage of renal disease (ESRD) is considered a public health problem with serious repercussions to an individual and to a family such as in the social and eco-

nomie levels. The vascular access is a major reason of mobilization of financial sources in health systems for people with ESRD on hemodialysis (HD).^{1,2} Dysfunction of vascular access represents around 20% to 25% of hospitalizations of patients undergoing dialysis.^{3,4} The United States of America provides approximately one billion dollars for the maintenance of vascular access,² reflecting approximately 6.7 to 7.9 thousand dollars per patient each year, which means 17% of the available resources for the treatment of HD.⁵

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The functional arteriovenous fistula (AVF) is considered by the scientific community as the vascular access of excellence for treating HD, due to its prolonged patency and fewer complications. Several methods are recommended for the detection of complications with the AVF such as physical examination, intra-access blood flow, rate of recirculation and static venous pressure.⁶⁻⁹

Performing systematic examination of the AVF has demonstrated its efficacy in detecting an impaired access and in identifying complications.^{8,10} This examination is carried out through inspection, palpation and auscultation of the AVF, all of which are easily implemented and providing a high level of accuracy.¹⁰⁻¹² With its implementation, one can identify the majority of venous stenosis cases.^{10,13,14} Several authors describe the contributions that nurses can provide in the detection of problems or complications that may compromise the functioning of AVF.^{6,7,15-17} Experienced nurses are important in the reduction of access thrombosis; this reduction in the rate of thrombosis can be up to 11%.¹⁸ Robbin et al. (2002)¹⁹ evidenced that nurses with more than 5 years of experience in dialysis are able to detect through physical examination the AVF maturation in 80% of the cases.

Studies involving the detection of complications with vascular access by nurses are scarce. We decided to evaluate the elements of physical examination that nurses considered in the detection of complications of the AVF in various HD centers. The time of professional experience considered was less than 5 years and over 5 years. Our aim was to compare the influence of professional experience of nurses in the detection of venous stenosis and steal syndrome.

METHODS

The study took place in eight HD centers between May and September of 2011 in the north of Portugal. Sample was constituted by registered nurses, selected by convenience, who provided nursing care to individuals with AVF in HD. All nurses who had more than 1 year of professional experience were selected. Nurses who worked in two or more HD centers were selected only once. Data collection was done through a questionnaire designed by the authors. The following data was collected: age, sex, practical training (clinical training), theoretical training (congresses/conferences and courses). Besides the data collected, some open questions were made. The nurses were asked about how they proceed in the detection of complications with AVF.

Two experts in physical examination of vascular access validated the answers mentioned by the participants in the detection of venous stenosis and steal syndrome. The elements of examination used in this study were based on information given by Beathard (1992, 1998)^{11,12} and Sousa et al. (2013).²⁰ Venous stenosis was considered when the following was found during the inspection: narrowing of the drainage vein; lack of drainage vein; arm elevation test; presence of aneurysms; and presence of collaterals veins. During the palpation, it was considered when the following was found: hyperpulsatile pulse; pulse augmentation test and discontinuous or absent thrill. Furthermore during the auscultation, it was considered when systolic bruit was found.

Steal syndrome was considered when the following was found during the inspection: pale hand; cyanotic hand; discoloration of the nail bed; peeling hand; and trophic lesions (nails, loss of hair, muscle atrophy). During the palpation, it was considered when the following was found: cold hand; functional impotence; pain in the mobilization of the hand and arterial pulses. Furthermore during auscultation, it was considered when diastolic and systolic bruit was found. Data collection was initiated after approval by the ethical committee of the institutions that participated in the study.

To compare the variables of the demographic characteristics between the groups we used the Mann-Whitney test. The Fisher test was used to compare the practice of care of nurses in detecting complications between the groups. All P values were considered significant if <0.05. Analysis was performed with Statistical Package for the Social Sciences software (version 17.0; SPSS Inc., Chicago, IL, USA).

RESULTS

The population was constituted by 203 nurses, 45 worked in more than one HD center, 23 nurses had less than 1 year of experience. The final sample was constituted by 135 nurses. We analyzed a total of 92 nurses, 34 of them had less than 5 years and 58 nurses had more than 5 years of professional experience. The nurses were divided in two groups: group 1 and group 2. The youngest participant in group 1 was 25 years old, and the oldest participant in group 2 was 62 years old.

Demographic characteristics were similar in both groups without statistically significant differences (Table 1). Females represented the majority in both groups, being 62% and 74% respectively in group 1 and group 2. Regarding the practical training, there was

Table 1 Demographic characteristics of the sample

	Group 1 (1–5 y)	Group 2 (>5 y)	P value
N	34	58	—
Age	32.6 ± 13.1	39.7 ± 8.2	0.354
Sex (Female)	21 (62%)	43 (74%)	0.312
Formation			
Theoretical	34 (100%)	58 (100%)	1.000
Practice	6 (18%)	7 (12%)	0.666

no difference between both groups (18% vs. 12%, $P = 0.666$).

In relation to the practices considered by the nurses in the detection of venous stenosis, there were no differences

between the groups ($P > 0.05$). However, the “systolic bruit” is the most considered in the two groups, 55% and 40% respectively in group 1 and group 2. Meanwhile, the aspect of “pulse augmentation test” is not considered in the detection of venous stenosis by nurses (Table 2).

Regarding steal syndrome, there were no differences between the groups in the practices of the nurses in the detection of this complication of the AVF ($P > 0.05$) (Table 3).

DISCUSSION

The physical examination of the vascular access allows identification of problems and complications affecting the functioning of AVF^{2,21,22}. Nurses are in a unique position to conduct the physical examination regarding vascular

Table 2 Interventions of nurses in the detection of venous stenosis

	Group 1 (1–5 y) (n, %)	Group 2 (>5 y) (n, %)	P value
Inspection			
Narrowing of the vein drainage	10 (29)	8 (14)	0.204
Lack of drainage vein	6 (17)	4 (6)	0.208
Arm elevation test	3 (8)	1 (2)	0.250
Presence of aneurysms	9 (25)	15 (27)	1.000
Presence of collaterals	4 (13)	1 (2)	0.101
Palpation			
Hyperpulsatile pulse	5 (16)	7 (12)	0.730
Pulse augmentation test	0 (0)	0 (0)	1.000
Discontinuous or absent thrill	15 (44)	22 (38)	0.801
Auscultation			
Systolic bruit	19 (55)	23 (40)	0.298

Table 3 Interventions of nurses in the detection of steal syndrome

	Group 1 (1–5 y) (n, %)	Group 2 (>5 y) (n, %)	P value
Inspection			
Discoloration of the nail bed	5 (15)	6 (11)	0.716
Trophic lesions	3 (7)	7 (13)	0.702
Peeling hand	1 (4)	0 (0)	0.365
Pale hand	5 (15)	15 (26)	0.383
Cyanotic hand	25 (74)	42 (72)	1.000
Palpation			
Cold hand	30 (88)	47 (81)	0.739
Functional impotence	1 (4)	5 (9)	0.656
Pain to mobilize the hand	4 (13)	10 (17)	0.739
Distal arterial pulses	4 (13)	5 (9)	0.682
Auscultation			
Diastolic and systolic bruit	9 (27)	18 (30)	1.000

access because they puncture the AVF every 2 days. Thereby, a nurse plays a fundamental role regarding the detection of complications of the AVF in order to obtain health gains for the person/company.²³ With these results it is shown that there are no significant differences between the two groups. Professional experience does not influence the practice of care of the nurses in the detection of vascular access complications, including venous stenosis and steal syndrome. However, it appears that in venous stenosis the factor “arm elevation test” is valued in the inspection by 8% (n = 3) of nurses in group 1 and 2% (n = 1) of nurses in group 2. This is an extremely low value considering the importance of this test in the detection of the exact location of the obstruction in the draining vein.²⁰ Also, none of the nurses from both groups considered the aspect “pulse augmentation test” during palpation. This is an important test in the detection of fair anastomotic stenosis, consisting of the compression of the draining vein until disappearance of thrill, all veins become hyperpulsatile (this means that the inflow is normal); if the draining vein does not become hyperpulsatile (this means that the inflow is abnormal), there may be a stricture.²⁴ This study contains aspects that are associated with physical examination in the detection of venous stenosis that are not considered by nurses regardless of time of professional experience.

The steal syndrome is rare but easily recognized.²⁵ Diagnosis is usually established by clinical history and physical examination. Typically, the symptoms begin with a cooling and tingling hand, as pallor, and often pain with mobilizing hand. The hand can turn blue and trophic lesions (nails, loss of hair and muscle atrophy) and ulcers can appear. This study evidences that professional experience does not influence the practices of nurses in the detection of steal syndrome. It is noted that nurses in both groups primarily value aspects associated with cyanotic hand (74% vs. 72%) in the inspection, and cold hand (88% vs. 81%) in the palpation. This shows that nurses, regardless of professional experience, are awakened in detecting early symptoms of steal syndrome. However, a small percentage of nurses made the palpation of distal arterial pulses (9% to 13%). It is important to assess the arterial pulses (radial and ulnar) to detect the decrease in distal perfusion, for “deviation” of the blood flow to the AVF.²⁰

It is noted that a reduced number of nurses had practical training (18% vs. 12%). This situation does not allow nurses to acquire and develop skills in detecting complications of the AVF through physical examination in a real context. This may possibly be associated with the fact that they do not have adequate training to enable them to carry out physical examination in their clinical practice. Turmel-

Rodrigues (2003)¹³ and Linardi et al. (2004)²⁶ evidenced that nurses do not have skills to assess and detect changes that may occur with the AVF. Early identification of any changes in the performance of AVF allows interventions to be provided before the acute loss of access, which would mean not placing a central venous catheter, decreasing the risk of sepsis.

Based on these results, we can deduce that nurses in care practice do not integrate all aspects associated with the physical examination to detect venous stenosis and steal syndrome in their professional context. Perhaps the existence of training programs geared towards nursing staff can organize and provide important information for the development of scientific capacity and skills to evaluate the AVF.

A potential limitation of this study is the use of a convenience sample. This issue limits our ability to generalize our results across a larger population of nurses. Furthermore, because the measures rely on self-reporting, the findings may not reflect true behaviors.

RELEVANCE TO CLINICAL PRACTICE

This work allows realization that only some aspects of physical examination are used by nurses in their clinical context. The HD centers should promote continuous training programs, particularly practical training that allows nurses to develop instrumental skills in the assessment of vascular access.

CONCLUSION

This study shows that professional experience does not influence the detection of venous stenosis and steal syndrome by nurses. The nurses from both groups do not select all the elements that constitute the physical examination in the detection of these complications. Nurses do not integrate in their clinical practice all aspects related to the physical examination to detect venous stenosis and steal syndrome.

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REFERENCES

- 1 Khan S, Amedia CA Jr. Economic burden of chronic kidney disease. *J Eval Clin Pract.* 2008; **14**:422–434.
- 2 Campos RR, Chula DC, Perreto S, Riella MC, do Nascimento MM. Accuracy of physical examination and

- intra-access pressure in the detection of stenosis in hemodialysis arteriovenous fistula. *Semin Dial*. 2008; **21**:269–273.
- 3 Allon M, Robbin M. Increasing arteriovenous fistulas in hemodialysis patients: Problems and solutions. *Kidney Int*. 2002; **62**:1109–1124.
 - 4 Rayner HC, Pisoni RL, Bommer J, et al. Mortality and hospitalization in haemodialysis patients in five European countries: Results from the Dialysis Outcomes and Practice Patterns Study (DOPPS). *Nephrol Dial Transplant*. 2004; **19**:108–120.
 - 5 Olmos A, López Pedret J, Piera L. Acceso vascular en hemodiálisis. In: Arias M, Aljama P, Valderrábano F, eds. *Insuficiencia Renal Progresiva*. Madrid, Grupo Entheos. 2000; 171–184.
 - 6 NKF-K/DOQI, Kidney Disease Outcomes Quality Initiative. Clinical practice guidelines for vascular access: Update. *Am J Kidney Dis*. 2006; **48**(Suppl 1):S176–S276.
 - 7 Tordoir J, Canaud B, Haage P, et al. EBPG (European Best Practice Guidelines) on vascular access. *Nephrol Dial Transplant*. 2007; **22**(Suppl 2):ii88–ii117.
 - 8 Tessitore N, Bedogna V, Melilli E, et al. In search of an optimal bedside screening program for arteriovenous fistula stenosis. *Clin J Am Soc Nephrol*. 2011; **6**:819–826.
 - 9 Besarab A, Sullivan KL, Ross RP, Moritz MJ. Utility of intra-access pressure monitoring in detecting and correcting venous outlet stenoses prior to thrombosis. *Kidney Int*. 1995; **47**:1364–1373.
 - 10 Coentrão L, Faria B, Pestana M. Physical examination of dysfunctional arteriovenous fistulae by non-interventionalists: A skill worth teaching. *Nephrol Dial Transplant*. 2012; **27**:1993–1996.
 - 11 Beathard GA. Physical examination of AV grafts. *Semin Dial*. 1992; **5**:74.
 - 12 Beathard GA. Physical examination of the dialysis vascular access. *Semin Dial*. 1998; **11**:231–236.
 - 13 Turmel-Rodrigues L. Acessos arteriovenosos para hemodiálise. *Rev Port Nefrol Hipert*. 2003; **17**:183–188.
 - 14 Tessitore N, Bedogna V, Lipari G, et al. Bedside screening for fistula stenosis should be tailored to the site of the arteriovenous anastomosis. *Clin J Am Soc Nephrol*. 2011; **6**:1073–1080.
 - 15 Safa AA, Valji K, Roberts AC, Ziegler TW, Hye RJ, Oglevie SB. Detection and treatment of dysfunctional hemodialysis access grafts: Effect of a surveillance program on graft patency and the incidence of thrombosis. *Radiology*. 1996; **199**:653–657.
 - 16 Polo JR. Accesos vasculares para diálisis. Detección y tratamiento de la disfunción por estenosis. *Rev Soc Esp Enferm Nefrol*. 2001; **15**:20–22.
 - 17 Sousa CN. Caring for the person arteriovenous fistula: Model for continuous improvement. *Rev Port Sau Pub*. 2012; **30**:11–17.
 - 18 Young EW, Dykstra DM, Goodkin DA, Mapes DL, Wolfe RA, Held PJ. Hemodialysis vascular access preferences and outcomes in the Dialysis Outcomes and Practice Patterns Study (DOPPS). *Kidney Int*. 2002; **61**:2266–2271.
 - 19 Robbin ML, Chamberlain NE, Lockhart ME, et al. Hemodialysis arteriovenous fistula maturity: US evaluation. *Radiology*. 2002; **225**:59–64.
 - 20 Sousa CN, Apóstolo JL, Figueiredo MH, Martins MM, Dias VF. Physical examination: How to examine the arm with arteriovenous fistula. *Hemodial Int*. 2013; **17**:300–306.
 - 21 Konner K, Nonnast-Daniel B, Ritz E. The arteriovenous fistula. *J Am Soc Nephrol*. 2003; **14**:1669–1680.
 - 22 Ball LK. Improving arteriovenous fistula cannulation skills. *Nephrol Nurs J*. 2005; **32**:611–617.
 - 23 Pile C. Hemodialysis vascular access: How do practice patterns affect outcomes? *Nephrol Nurs J*. 2004; **31**:305–308.
 - 24 Beathard G. An algorithm for the physical examination of early fistula failure. *Semin Dial*. 2005; **18**:331–335.
 - 25 Rocha A, Silva F, Queirós J, Malheiro J, Cabrita A. Predictors of steal syndrome in hemodialysis patients. *Hemodial Int*. 2012; **16**:539–544.
 - 26 Linardi F, Bevilacqua JL, Morad JFM, Costa JA. Programa de melhoria continuada em acesso vascular para hemodiálise. *J Vasc Br* 2004; **3**:191–196.

SUPPORTING INFORMATION

Additional Supporting Information may be found in the online version of this article at the publisher's web site:

Appendix S1. Questionnaire applied for the study.