



ORIGINAL

Value of doppler ultrasonography in the study of hemodialysis peripheral vascular access dysfunction[☆]

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Abstract

Objective: The main objectives of this study were to evaluate the sensitivity and specificity of duplex Doppler ultrasonography in the study of hemodialysis peripheral vascular access dysfunction and to analyze the resistance index and flow in the afferent artery.

Materials and methods: We prospectively studied 178 patients with 178 peripheral vascular accesses that were dysfunctional in at least three consecutive hemodialysis sessions. Patients underwent duplex Doppler ultrasonography and clinical and laboratory follow-up for three months (provided angiography findings were negative). We calculated the sensitivity, specificity, predictive values, and coefficients of probability. We studied the morphology of the afferent artery, the arteriovenous anastomosis, and the efferent vein, and we measured the resistance index and the flow of the afferent artery, the diameter of the anastomosis, and the flow and peak systolic velocity in the efferent vein.

Results: The final sample consisted of 159 patients. The sensitivity, specificity, positive and negative predictive values, and positive and negative coefficients of probability were 0.98 (95% CI: 0.88–1.00), 0.74 (95% CI: 0.66–0.81), 0.96, 0.82, 3.7, and 0.03, respectively. The resistance index was less than 0.5 in 78.5% of the peripheral vascular accesses with normal function and greater than 0.5 in 86.1% of the dysfunctional peripheral vascular accesses. We found aneurysms in 19 of the native peripheral vascular accesses and pseudoaneurysms in 7 of the prosthetic grafts. Inverted flow was seen in 57 peripheral vascular accesses.

Conclusion: Duplex Doppler ultrasonography is an efficacious method for detecting and characterizing stenosis and thrombosis in peripheral vascular accesses, and it provides information about the morphology and hemodynamics.

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PALABRAS CLAVE

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Valor de la ecografía doppler en la disfunción de los accesos vasculares periféricos para hemodiálisis**Resumen**

Objetivo: El objetivo principal del estudio es evaluar la sensibilidad y especificidad de la ecografía dúplex-Doppler para estudiar la disfunción de los accesos vasculares periféricos para hemodiálisis, y analizar el índice de resistencia y el flujo en la arteria aferente.

Material y métodos: Se estudiaron prospectivamente 178 pacientes con 178 accesos vasculares periféricos disfuncionantes durante al menos 3 sesiones de hemodiálisis seguidas. Se realizaron ecografía dúplex-Doppler, angiografía y seguimiento clínico y analítico durante 3 meses (si la angiografía fue negativa). Se calcularon los valores de sensibilidad, especificidad, valores predictivos y cocientes de probabilidad. Se estudiaron morfológicamente la arteria aferente, la anastomosis arteriovenosa y la vena eferente, y se midieron el índice de resistencia y el flujo de la arteria aferente, el diámetro de la anastomosis, y el flujo y velocidad picosistólica en la vena eferente.

Resultados: La muestra final la constituyeron 159 pacientes. Los valores de sensibilidad, especificidad, valor predictivo positivo y negativo y cociente de probabilidad positivo y negativo, fueron 0,98 (IC 95% 0,88–1), 0,74 (IC 95% 0,66–0,81), 0,96, 0,82, 3,7 y 0,03 respectivamente. El índice de resistencia fue <0,5 en el 78,5% de los accesos vasculares periféricos normofuncionantes y >0,5 en el 86,1% de los disfuncionantes. Se encontraron aneurismas en 19 de los accesos vasculares periféricos nativos y pseudoaneurismas en 7 de los protésicos. El flujo invertido apareció en 57 accesos vasculares periféricos.

Conclusión: La ecografía doppler dúplex es un método eficaz de detección y caracterización de estenosis y trombosis del accesos vasculares periféricos y aporta información morfológica y hemodinámica.

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Introduction

Chronic kidney disease (CKD) is an increasingly important health issue whose incidence and prevalence have skyrocketed during the last years.¹ End-stage renal disease is defined as the situation in which native kidneys fail as the metabolic regulating organ of the internal environment leading to the necessary substitution of such kidneys through hemodialysis or kidney transplant. Hemodialysis that is still the main option when we talk about substitute therapy needs one hemodialysis fistula or peripheral vascular access (PVA).¹ PVA needs at least 600–800 ml/min of blood flow^{2–4} to allow the elimination of uremic toxins in a reasonable amount of time. This is why PVA (native or graft) is key for the survival of these patients. PVA lesions are common—primary patency is 79.5%/year and 48% every 4 years⁵—and they usually condition thrombosis and closure of PVA or flow reductions in cases of stenoses in venous or arterial branches. The PVA dysfunctions or thromboses are the top resource consumers in the population with CKD. It is necessary to proceed with the early detection of dysfunction in an attempt to fix the dose of hemodialysis and find treatable structural lesions to avoid thrombosis and increase survival.

Angiography is the agreed standard of reference for the monitoring of the PVA status but it is an expensive aggressive modality that needs to be avoided and used only for diagnostic purposes. Yet despite the following issues shown by the duplex-Doppler ultrasound (DDU): operator dependence, interference of bandages and lesions, and vessel calcifications that complicate the assessment of anastomotic

stenoses,⁶ PVAs are more and more studied with DDU before the angiography given the information delivered by the DDU is not only information on the morphological fistula but also on the efferent artery and the inflow and outflow flows with the advantage that it is a non-invasive modality, does not use ionizing radiations or iodinated contrast media and is cheap and accessible. Even though there are several studies in which DDU is the same^{6–10} or even better^{7,11} than angiographies to locate and assess the degree of stenosis of the PVA there are not too many observational prospective studies to assess their performance when there is suspicion of PVA dysfunction and to determine the causes of the DDU error.⁶ The main goal of this study is to evaluate the sensibility and specificity of DDU in the dysfunctions of PVA. The secondary goal is to analyze the resistive index (RI) and the afferent arteriole flow of normal and dysfunctional PVAs and to show the main non-hemodynamic morphological findings associated.

Materials and methods**Patients**

From October 1, 2008 to December 31, 2011 the data of 178 PVAs with suspicion of dysfunction pertaining to 55 women (34.6%) and 104 men (65.4%) were prospectively collected. The average age was 24–92 years (media: 6611 years). The study was approved by the hospital ethical committee. In [Table 1](#) the epidemiological data of our sample can be seen.

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