



ORIGINAL REPORT

Invasive radiologic management of hemodialysis fistulas: Measuring flow with an endovascular catheter[☆]



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KEYWORDS

Vascular access;
Hemodialysis;
Vascular flow;
Thermodilution;
Angioplasty;
Ultrasonography

Abstract

Objectives: To analyze the values of flow obtained with an endovascular catheter, and to determine whether they are more reliable than angiographic and clinical findings for planning and for determining the outcome of invasive radiologic treatment of hemodialysis fistulas, as well as to determine the safety of this technique during interventional radiology procedures.

Material and methods: We used endovascular catheters to measure flow in 341 vascular accesses for hemodialysis (162 [47.6%] distal fistulas, 132 [38.4%] humeral fistulas, and 47 [14%] arteriovenous grafts) in 598 procedures (a total of 3051 flow measurements). Dysfunction was most commonly due to high pressures and flow deficits.

Results: The catheter was used to measure the results of radiologic treatment in 419 (70%) cases and only to measure the control of flow in the hemodialysis access in 179 (30%) cases. In the cases where lesions of the access had been treated radiologically, the flow improved by a mean of 1232 ml/min. In 2 (0.35%) cases, the tip of the catheter perforated the wall of the vein; this complication was resolved by inflating a low pressure balloon.

Conclusions: Endovascular catheters are useful for measuring flow in invasive vascular radiology procedures for hemodialysis. In assessing the hemodynamic status of a vascular access, they are most helpful in determining whether stenosis is present.

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PALABRAS CLAVE

Acceso vascular;
Hemodiálisis;
Flujo vascular;
Termodilución;
Angioplastia;
Ultrasonografía

Manejo radiológico invasivo de las fístulas de hemodiálisis midiendo el flujo con un catéter endovascular

Resumen

Objetivos: Analizar los valores del flujo obtenidos con un catéter endovascular y demostrar que son más fiables que los hallazgos angiográficos y clínicos para planificar y determinar el

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resultado del tratamiento radiológico invasivo de las fístulas de hemodiálisis, así como demostrar su seguridad durante los procedimientos intervencionistas.

Material y métodos: Medimos con el catéter 341 fístulas de hemodiálisis en 598 procedimientos. En total, se hicieron 3.051 medidas de flujo. Fueron 162 fístulas distales (47,6%), 132 humerales (38,4%) y 47 injertos protésicos (14%). Los motivos de disfunción más frecuentes fueron las presiones elevadas y el déficit de flujo.

Resultados: El catéter se utilizó para medir el resultado del tratamiento radiológico en 419 casos (70%) y solo para medir el control del flujo del acceso en 179 casos (30%). En los casos en los que se trataron radiológicamente las lesiones del acceso, el flujo mejoró en 312 ml/min de media. Los casos no tratados presentaron un flujo medio de 1.232 ml/min. En 2 casos (0,35%) la punta del catéter perforó la pared de la vena, que se resolvió inflando un balón a pocas atmósferas.

Conclusiones: El catéter endovascular medidor de flujos es una herramienta útil en los procedimientos invasivos de radiología vascular para hemodiálisis. Al valorar el estado hemodinámico del acceso vascular, su mayor utilidad es que ayuda a tomar la decisión de tratar o no una estenosis.

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Introduction

In time hemodialysis fistulas usually evolve into stenosis that diminish the flow and deteriorate the quality of dialysis.¹ In the early 1990s clinical studies proved that measuring the fistula flow rate was usually prior to thrombosis.² It could be confirmed that if stenosis could not be corrected through angioplasty the fistula ended up thrombosed.³ Later it was confirmed that not all angioplasties considered successful by the radiologist improved the flow of fistula.⁴ Usually a successful angioplasty in one hemodialysis fistula stenosis is determined through physical exploration and one angiography.⁵ However these are not objective data and in certain situation the final outcome of therapy can be tricky.⁶ This is why we need an instrument to establish what the flow improvement after the angioplasty really is and in order to avoid poor hemodynamic outcomes despite good angiographic outcomes.⁷ One system allowing us to measure flow in situ immediately after the angioplasty will provide us information on any increases objectively.⁷

The Doppler ultrasound is a tool used to assess the fistula flow. It is useful for the diagnosis of fistula dysfunction and fistula monitoring over time. The drawback in the vascular radiology room is that an expert in this field is needed. The flow measuring catheter-based proceeding is fast and no special set of skills to use it are needed; it is not expensive and makes the use of the angioplasty balloons needed in every proceeding profitable.⁶

The main goal of this study is analyzing the flow values obtained with the endovascular catheter and proving that they are more reliable than any angiographic and clinical findings in order to plan and determine the outcome of the invasive radiologic therapy of the hemodialysis fistulae. Also another goal has been to show any possible complications and the catheter safety during interventional proceedings.

Materials and methods

Patients and vascular accesses

We studied retrospectively the outcomes of the last 6 years of the flow measuring-endovascular catheter ReoCath™ Flow Catheter (Transonic Systems Inc., Ithaca, New York, USA) in 341 hemodialysis fistulae. The proceeding was explained to all patients and all gave their written informed consent, also having the approval from the hospital ethical committee. We included all dialysis fistulae that showed some kind of dysfunction based on dialytic parameters. The fistulae in which the ultrasound discarded all kinds invasive radiologic proceedings were not included. The average age of patients was 62 years of age (range: 21–88 years; 60% males). Forty-eight per cent of fistulae were distal (radial or cubital), 38% humeral fistulae and 14% prosthetic grafts made out of polytetrafluoroethylene.

Study technique

The ReoCath™ Flow Catheter is a disposable catheter with an extension cord connected to one machine that measures the flow. Based on the direction of flow used for working the catheter can be antegrade or retrograde; both are 6 French caliber-catheters with a non-intense light and thus they cannot advance on the wire. Before flow measuring one fistulography is performed through retrograde approach of the artery or through vein puncture directed toward the venous anastomosis (retrograde-wise) or (antegrade-wise) in an effort to assess the whole vascular territory from the afferent artery to cardiac cavities. After diagnosis the catheter is inserted through with one introducer with the help of a fluoroscopic or ultrasound wire (Fig. 1). Then through one cord extender the catheter is connected to a screen; measurement is performed by injecting one 10 ml-bolus of saline solution at room temperature.

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