Novel assessment of haemodynamics in the peripheral vasculature using Combowire

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Disclosures

None relevant to this talk
Optimal assessment of peripheral vasculature

- Functional assessment
- Effect of exercise
- Multi-level disease
- Collaterals
- Microcirculation
- Tissue perfusion
Appearances are often deceiving.
Invasive haemodynamic assessment
Fractional Flow Reserve (FFR)

- Index of the physiologic significance of stenosis
- Maximal blood flow in stenotic artery: normal maximal flow
- Hyperaemia induces a pressure drop
- FFR <0.8 = 90% predictive of coronary ischaemia
Hyperaemia: Achieving maximal blood flow
FFR Guided selection of coronary lesions that merit treating

- FFR threshold (<0.8)
- FFR vs angio guided treatment
- No. stents used 2.7 vs 1.9 (p<0.001)
- MI/death 13% vs 9% (P<0.02)
Stenosis >70%
FFR 0.93
Fractional flow reserve in below the knee arteries with critical limb ischemia and validation against gold-standard morphologic, functional measures and long term clinical outcomes

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<tr>
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<th>Before Intervention</th>
<th>After Intervention</th>
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<td>Diameter stenosis (%)</td>
<td>65 +/-23</td>
<td>26 +/-13</td>
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<tr>
<td>FFR</td>
<td>0.60 +/-0.19</td>
<td>0.77 +/-0.12</td>
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FFR 0.5 predicts >70% visual stenosis

Cardiovasc Revasc Med 2017
Ability of Fractional Flow Reserve to Predict Restenosis After Superficial Femoral Artery Stenting

Norihiro Kobayashi, MD, Keisuke Hirano, MD, Masahiro Yamawaki, MD, PhD, Motoharu Araki, MD, Tsuyoshi Sakai, MD, Hideyuki Takekura, MD, Yasunari Sakamoto, MD, Shinsuke Mori, MD, Masakazu Tsutsumi, MD, Takuro Takama, MD, Yohsuke Honda, MD, Takahiro Tozuda, MD, Kenji Makino, MD, Shigemitsu Shirai, MD, and Yoshiaki Ito, MD

Abstract

Purpose: To evaluate the clinical efficacy of poststenoring fractional flow reserve (FFR) in terms of predicting restenosis in superficial femoral artery (SFA) disease. Methods: This prospective, single-center, nonrandomized study enrolled 48 patients (mean age 76.8 ± 9 years; 38 men) with 51 SFA lesions from July 2013 to June 2014. Mean FFR (distal mean pressure/proximal mean pressure) and systolic FFR (distal systolic pressure/proximal systolic pressure) were calculated, and the relationship between these FFR values and restenosis at 12 months was investigated using receiver operating characteristic (ROC) curve analysis. Results: Poststenoring FFR was significantly lower in the restenosis group (poststenoring mean FFR 0.85 ± 0.07 vs 0.93 ± 0.05, p < 0.001; poststenoring systolic FFR 0.76 ± 0.14 vs 0.87 ± 0.08, p = 0.015). The area under the ROC curve for restenosis in poststenoring mean FFR was higher, but not statistically significant, than that in poststenoring systolic FFR (0.84 vs 0.74, p = 0.08). The best poststenoring mean FFR cutoff value for predicting restenosis was 0.92 (sensitivity 0.64, specificity 0.91). The 4.5% restenosis rate at 12 months in the high (>0.92) poststenoring mean FFR group was significantly lower (3.57%, p = 0.008) than in the low (<0.92) poststenoring mean FFR group. Conclusion: Poststenoring mean FFR is useful for predicting restenosis in SFA disease.

Keywords
angioplasty, endovascular therapy, fractional flow reserve, nitinol stent, restenosis, occlusion, stenosis, superficial femoral artery

Introduction

Endovascular therapy (EVT) for superficial femoral artery (SFA) disease has been widely used and recommended as a first-line therapy. In addition to percutaneous transluminal angioplasty (PTA) and the use of bare metal and drug-eluting stents, the efficacy of current drug-coated balloons and atherectomy devices has been reported. The appropriate uses of these treatment options according to the clinical and anatomic scenarios are continuously being investigated. In coronary artery disease (CAD), the efficacy of physiological assessment using fractional flow reserve (FFR) has been well investigated, and FFR is commonly used in daily practice. In addition, the FFR value after coronary stenting is reportedly associated with adverse events at follow-up. On the other hand, angiographic evaluation has been the major focus of studies investigating the efficacy of EVT for SFA disease. Recently, the use of intravascular ultrasound (IVUS) has been suggested to improve primary patency following nitinol stent implantation for SFA disease. The relationship between postintervention peripheral FFR and peak systolic velocity (PSV) was previously evaluated in only 1 study, however, details regarding the ability of FFR to predict SFA disease remain unknown. This study prospectively

Figure 4. Prevalence of restenosis at 12 months according to poststenoring mean fractional flow reserve (FFR) >0.92 or ≤0.92.

Kobayash et al. J Endovasc Ther 2016
➢ Collaterals > half of flow in normal arteries
➢ Prevents symptoms for 5mins of exercise
➢ Low collateral flow index: Poor exercise tolerance
Haemodynamic contribution of collaterals

Poor collaterals

Extensive collaterals

A Proximal Right EIA

B Distal Right EIA

C Proximal Left EIA

D Distal Left EIA
HeartFlow FFRCT for estimating fractional flow reserve from coronary CT angiography

- Non-invasive
- Safe
- High level of diagnostic accuracy
- May avoid invasive intervention
- Potential £9M NHS saving by 2022
Computational fluid dynamics

- Hypothetical physiological conditions
  - Non-pulsatile flow
  - Laminar flow
  - Maximal flow during exercise?
  - Arbitrary inflow/outflow conditions
  - Haemoglobin/blood constituents

- Validation with intra-arterial measurements

- Contribution of collaterals?

Xu et al. Nature Scientific Reports 2016
Computational Fluid Dynamics: SFA Stenosis
Non-invasive assessment of haemodynamics / tissue perfusion

A Distal Aorta Pressure/Velocity

B Right Distal EIA Pressure/Velocity

C Left Distal EIA Pressure/Velocity
Summary

➢ Wires allow refined haemodynamic assessment in the lower limb

➢ Invasive Pressure/Velocity measurement

➢ Targeted treatment

➢ Functional role of collaterals

➢ Non-invasive: Computational Fluid Dynamics
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