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Abstract: **P842**

A novel mathematical signal processing application which automates and improves the accuracy of FFR assessment

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Backgound: Fractional flow reserve (FFR) is the gold standard method to assess physiological lesion significance in the cardiac catheter laboratory in patients with coronary artery disease (CAD). When FFR is used to guide percutaneous coronary intervention (PCI), clinical and economic outcomes are improved. When assessing FFR it is important that operators record the translesional pressure ratio during the period of stable hyperaemia. Occasionally, operators inadvertently record prematurely during minimum or unstable FFR periods.

Purpose: We sought to develop an automated, software-based tool to accurately identify the period of stable hyperaemia and therefore the true FFR.

Methods: FFR was measured in patients with CAD, before and after PCI. The novel computational algorithm invoked a fast Fourier transformation (FFT) to decompose the proximal (Pa) and distal (Pd) pressure signals into the frequency domain. Extraneous frequencies (e.g. respiratory and cardiac variations) were filtered and the signal was reconstructed in the time domain using inverse FFT. The computer algorithm was programmed to automatically identified the phases of response to hyperaemia, in particular the minimum FFR (FFRmin) was differentiated from the true FFR (FFRtrue) during the period of stable hyperaemia.

Results: Invasive physiological data were collected from 163 coronary stenoses (93 patients). Mean FFR was 0.78 (SD=0.15). 81 lesions were physiologically significant (FFR≤0.80) and 82 were non-significant (FFR>0.80). The novel algorithm computed successfully in all cases (Figure), including 2 cases in atrial fibrillation, and successfully differentiated FFRmin from FFRtrue. Over all 163 cases, the FFR recorded in the catheter laboratory was significantly lower than the computed value (bias = -0.02, P<0.0001). 7.4% of "significant" lesions undergoing PCI (13% of patients) were re-classified as non-significant after the novel algorithm was applied. No non-significant cases were re-classified as significant. The algorithm computed in a mean time of 1.9 seconds on a standard office computer.

In Figure 1, (a) Pa and Pd during adenosine infusion. (b) Results of the novel algorithm. Blue line is the Pd/Pa ratio in time. Red line is the Euler derivative of the Pd/Pa. 4 points are identified: adenosine starts (blue circle), minimum FFR derivative (blue diamond), minimum FFR (green triangle), FFR at stable hyperaemia (red square).

Conclusions: We have developed a robust mathematical computational algorithm which, in the context of FFR measurement, (i) accurately identifies the period of stable hyperaemia and (ii) accurately reports the FFR during this period. This tool eradicates operator-dependent subjectivity in FFR interpretation. Although the absolute difference in reported FFR was small, the impact on treatment decisions was substantial. This automated software application could be simply integrated into existing physiological analyser hardware.

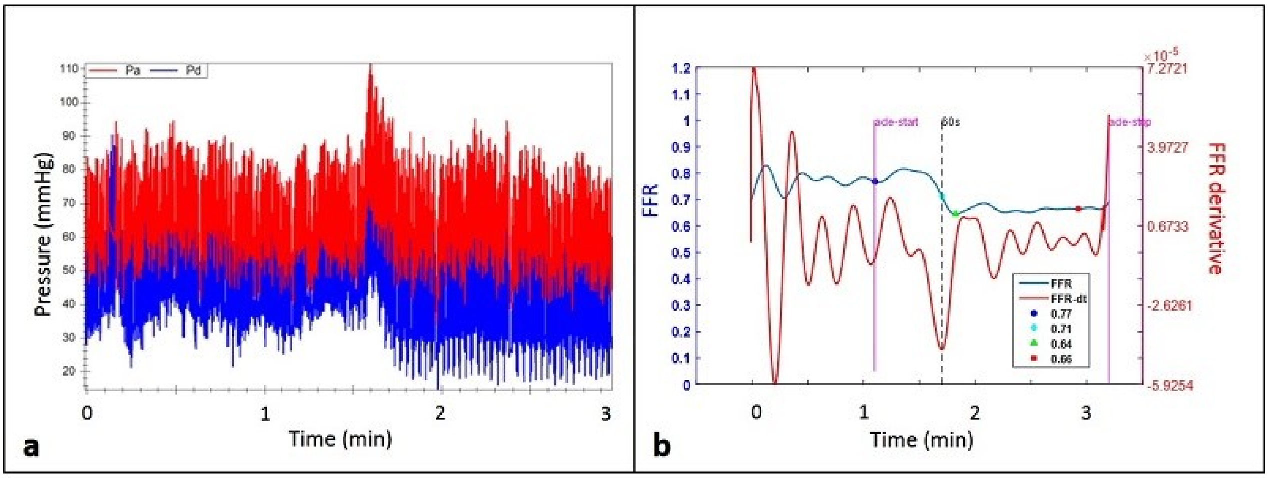

Figure 1. A result from the novel method.