Wire Free FFR
A review of the Evidence

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Questions for Wire-Free FFR

- Is it as accurate as conventional FFR?
- Is it technically challenging to perform?
- Will it lengthen procedure time?
- Is it cost effective?

- **Will it change the way we manage patients?**

Background

- FFR has become the gold standard (Level 1A) for assessing hemodynamic significance of intermediate stenosis[1]
- FFR reliably identifies ischaemia producing lesions and improves clinical outcomes[2]
- However, FFR assessment - costly pressure sensor guidewires into the coronary artery, usually along with the administration of a vasodilator to induce hyperaemia.

1 2011 AHA guidelines for PCI, Task Force on Myocardial revascularization ESC

2 De Bruyne et al 2012

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- CFD, when applied to CT in order to generate CT-FFR, has been shown to improve prediction of FFR[4]

- The Diagnostic accuracy of FFR-CT has been suboptimal so far[5]

4 Koo BK et al 2011,

5 Min JK et al 2012

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- A need for a fast, simplified assessment using QA and blood flow simulation (ie. Wire-Free FFR).

- Wire-free FFR requires 2 Angiographic projections, ideally >25degrees apart.

- Using Google Scholar, we were able to find 18 trials on wire-free FFR between 2013 and 2019.

- Systems used for wire-free FFR were:
  - Medis (QFR, Quantitative Flow Ratio)
  - Ansys Cfx (vFFR, Virtual FFR)
  - Pie Medical (Virtual Functional Assessment Index, VFAI)
  - CathWorks (FFR Angio)
  - RainMed (CAFFR)

Vessels Interrogated

LAD	
VFAI	64.7%
VFFR	N/A
QFR	51-64%
CAFFR	59.5%
FFR ANGIO	54.6%

LAD 50-65%

LCX	
VFAI	13.7%
VFFR	N/A
QFR	11-17%,
CAFFR	11.0%
FFR ANGIO	19.1%

LCX 11-19%

RCA	
VFAI	21.6%
VFFR	N/A
QFR	16-26.2%
CAFFR	26.5%
FFR ANGIO	24.1%

RCA 16-25%

Sample size: 19 – 361 vessels

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Exclusion Criteria

	VFAI	VFFR	QFR	CAFFR	FFR Angio
AMI	-	60 days	72 HRS	6 DAYS	1 YR (FAST FFR)
POOR EF	-	-	FAVOR, FAVOR II, WIFI	<50%	<45%
Bifurcation	NO	-	-	-	-
IRA	NO	-	-	-	-
RECENT PCI	-	-	-	-	12 MONTHS
CABG	-	NO	-	-	NO

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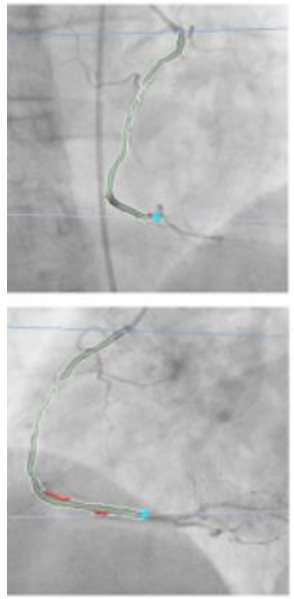
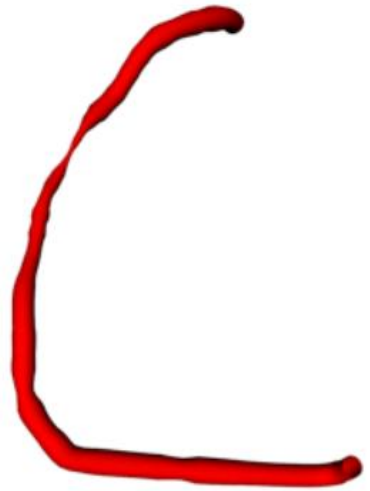
vFFR (ANSYS CFx)

Trial	Author	Year	Vessels (N)	Sensitivity	Specificity	Accuracy
VIRTU 1	Morris Et Al	2012-2013	17	97%	86%	97%
VIRTU Fast	Morris Et Al	2017	73	100%	100%	100%





VIRTU 1:

- Landmark Trial. First of its kind in wirefree FFR
- Long computation time. 24 hours offline analysis.

VIRTU Fast

- Rapid Computation Time
- Varied results according to vascular anatomy and microvascular resistance

- Parameters for Coronary Microvascular Resistance inferred from Invasive measurement.

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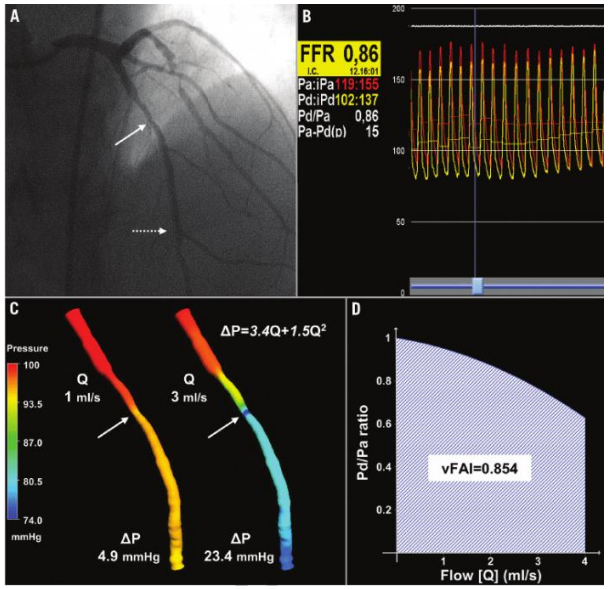
VFAI (Pie Medical)

Trial	Author	Year	Vessel (N)	Sensitivity	Specificity	Accuracy
-	Papafaklis et Al	2013	139	90%	86%	88%

- Did not include distal resistance in the assessment
- Infarct related Artery not included.
- Did not include Side Branches.

- Negative Predictive Value of 100% if >0.90.
  - 27% of cases deferred



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QFR (Medis)

Trial	Author	Year	Vessels (N)	Sensitivity(%)	Specificity (%)	Accuracy (%)
FAVOR	Tu Et Al	2014	77	**74**	91	86
FAVOR II	Xu Et Al	2017	328	94.6	91.7	92.7
FAVOR II J-E	Westra Et Al	2017	361	86.5	86.9	86.8
WIFI II	Westra Et Al	2017	240	77	86	83
-	Kamayama Et Al	2016	25	80	**80**	80
-	Yazaki Et Al	2016	151	89.1	88.6	88
	Van Rosendeal Et Al	2017	20	**100**	79	80
-	Legutko Et Al	2017	123	89.9	95.9	**100**
	Spitaleri Et Al	2018	49	88	**97**	94
	Emori Et Al	2018	75	87	92	82

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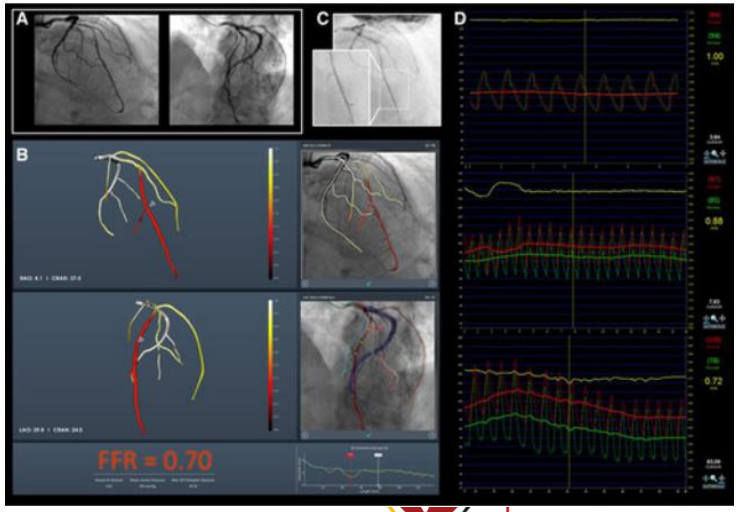
- FAVOR – Required the induction of hyperemia.
- Van Rosendeal – required hyperemia induction
- WIFI II – did not use bifurcation lesions. Assessment done offline. No ACS patients included.
- FAVOR II – No bifurcations assessed.

FFR Angio (Cathworks)

Trial	Author	Year	Vessel (N)	Sensitivity	Specificity	Accuracy
FAST FFR	Fearon Et Al	2018	319	93.5	91.2	92.2
-	Pellicano Et Al	2017	203	88	95	93
-	Trobs Et Al	2016	100	79	94	90

- Pellicano – Only assess stable CAD. All measurements were done offline.

- Diffusely diseased vessels were not interrogated.



CAFFR (RainMed)

Trial	Author	Year	Vessel (N)	Sensitivity	Specificity	Accuracy
FLASH FFR	Li Et Al	2019	328	90.4	98.6	95.7

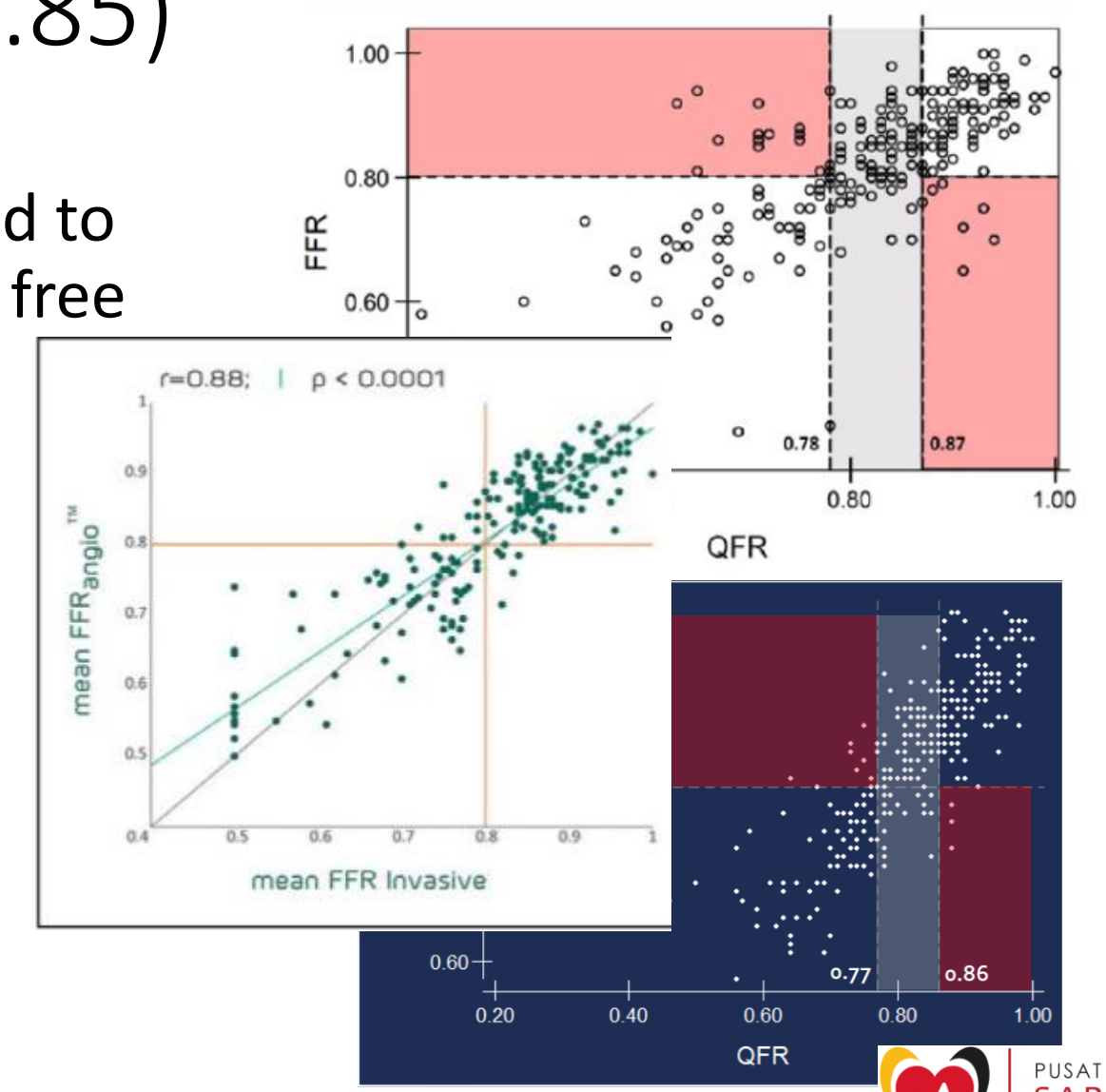
- Pressure Drift of the FFR wire or poor angiographic quality could cause discordance in results.

- Diffusely diseased arteries were not included.

Grey Zone (FFR 0.75-0.85)

FFR of between 0.75 – 0.85 seemed to show the most variation with wire free results.

System	Accuracy
VFAI	N/A
VFFR	N/A
QFR	71 - 86%
CAFFR	89.9%
FFR ANGIO	92%



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Challenges faced by Wire-Free FFR

- Coronary microcirculation and resistance are difficult to model. In Myocardial dysfunction (Diabetes/ post AMI) may cause an over estimation of the wire free FFR.

- Assumption that coronary flow is the same along the side branches (not taken into account). Thus, bifurcation lesions may be challenging to assess.

- Most trials used discreet stenosis, diffuse lesions may be more challenging to quantify.
- Some studies were done with offline computational analysis.
- Small Study population used.

- Good performance <0.75 and >0.85. Grey-zone - Variation between 0.75 – 0.85, possible need for Invasive FFR.

- **<u>Clinical judgements were based on Wired-FFR measurements. Direct evaluation of clinical outcome of wire-free FFR is not possible</u>**

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Potential for Clinical Use

- Not technically challenging, requires 2 angiographic images 25 degrees apart.
- Data acquisition causes minimal disruption in routine angiography.
- Processing time is rapid (usually around 5 minutes)

- Use in non culprit lesions in STEMI shows good correlation with invasive FFR.

- **<u>High diagnostic accuracy and high negative predictive value – may aid clinicians to identify patients that do not need wired FFR</u>**.

In Conclusion

- Trials looked a different lesions, in a heterogenous population, thus with variable outcomes.
- Difficult to compare the trials.
- Cut-off for Wire-Free FFR may not be the same as invasive FFR.
- Further outcome based trials are required.

Thank you

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