



Novel Methods to Predict and Assess AV Fistula Maturation

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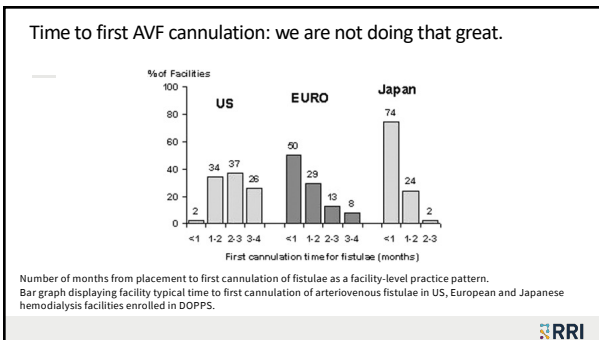


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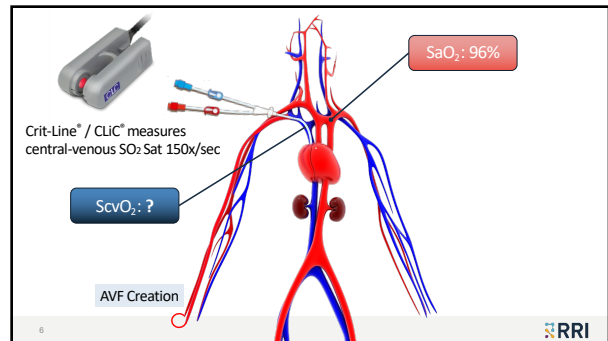
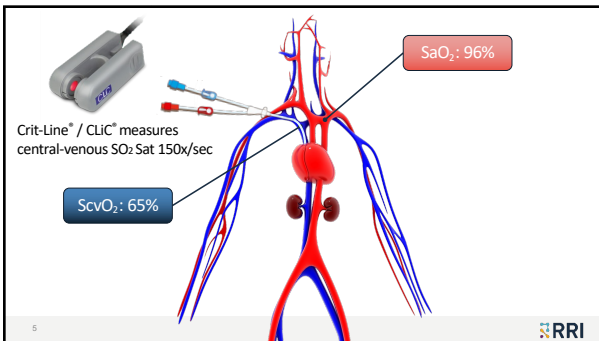
Disclosures

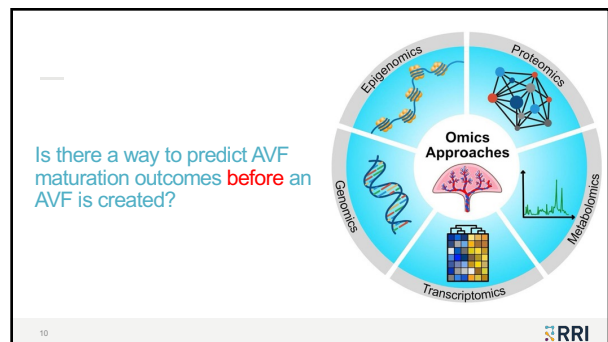
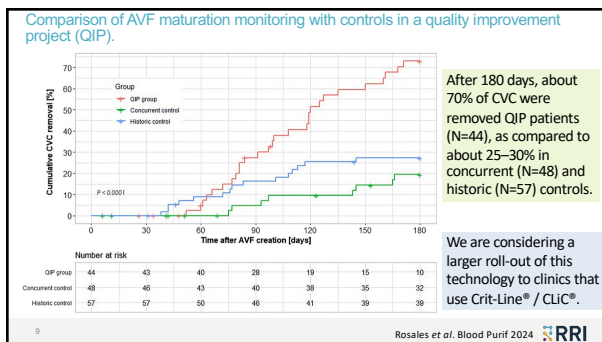
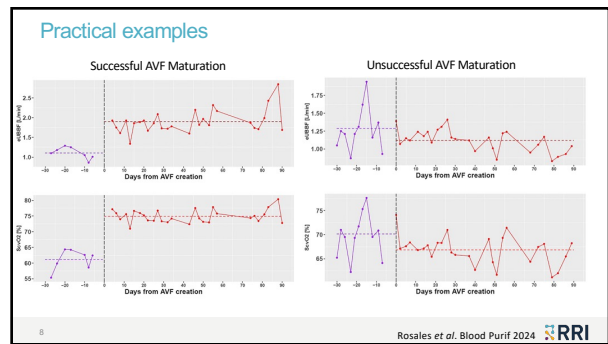
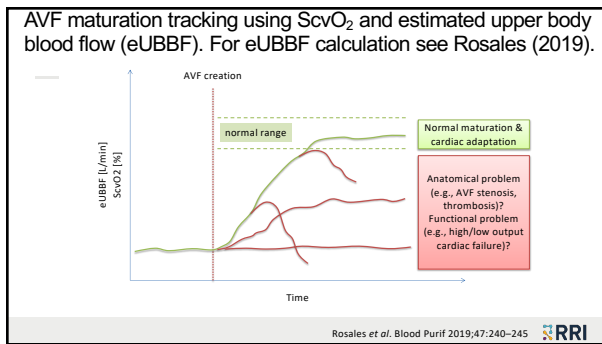
- I am an employee of the Renal Research Institute, New York, NY a wholly owned subsidiary of Fresenius Medical Care (FME)
- I hold stock in FME
- I am on the Editorial Boards of several kidney journals
- I am inventor on multiple patents in the medical fields
- My academic affiliations are with the Icahn School of Medicine at Mount Sinai, New York and the Medical University of Innsbruck, Austria.

Is there a way to follow AVF maturation whenever the patient has a hemodialysis session and that is essentially free?

Let's start with a thought experiment.



Pre-surgery plasma metabolites associate with AVF maturation outcomes.

Background

- Arteriovenous fistulas (AVFs) are the preferred vascular access for most hemodialysis (HD) patients.
- Previously (ASN Kidney Week, 2023), we showed that plasma metabolome clusters prior to AVF surgery associate with AVF maturation outcomes.
- Here we aim to annotate pre-surgery plasma metabolites as potential biomarkers of AVF maturation outcomes.

Methods

- Successful AVF maturation was defined as either adequate HD or a combination of ultrasound features (vein size > 4 mm with AVF flow > 500 ml/min) and clinical assessment.
- Pre-surgery plasma samples from 44 patients were analyzed by liquid chromatography-mass spectrometry.
- Metabolites were identified by matching to RRI's in-house and METLIN libraries.

	Entire cohort (N=44)	Maturation AVF (N=28)	Non-maturation AVF (N=16)	P-value
Demographics				
Male	36(81.8)	24(85.7)	12(75.0)	0.36
Age at surgery (year)	68.2±13.4	67.3±13.6	69.2±13.3	0.66
Covarain	34(77.3)	21(75.0)	13(81.3)	0.44
Comorbidities				
Diabetes mellitus	23(52.3)	14(50.0)	9(56.3)	0.45
Cardiovascular disease	28(63.6)	17(60.7)	11(68.8)	0.57
Hypertension	36(81.8)	20(71.4)	16(100.0)	0.39
Congestive heart failure	6(13.6)	3(10.7)	3(18.8)	0.30
Ischemic heart disease	38(86.4)	22(78.6)	16(100.0)	0.73
History of thromboembolism	7(15.9)	3(10.7)	4(25.0)	0.22
Peripheral vascular disease	7(15.9)	4(14.3)	3(18.8)	0.70
Medication				
Aspirin	23(52.3)	16(57.1)	7(43.8)	0.04*
Calcium	49(111)	30(107)	19(119)	0.42
Warfarin	5(11.4)	3(10.7)	2(12.5)	0.86
Diapyl status at AVF creation				
OD Stage 5D	13(29.5)	10(35.7)	3(18.8)	0.40
On hemodialysis	31(70.5)	18(64.3)	13(81.3)	0.14
On peritoneal dialysis	13(29.5)	17(60.7)	13(81.3)	0.30
Intubated	27(61.4)	18(64.3)	9(56.3)	0.60
Pre surgery blood test				
Hemoglobin (g/L)	111.1±14.8	109.4±15.3	113.3±12.8	0.44
Albumin (g/L)	35.1±5.4	34.4±5.9	32.6±4.7	0.05
Urea (mmol/L)	24.5±6.8	24.2±6.6	24.9±7.8	0.76
Creatinine (µmol/L)	336.1±100.4	332.0±102.5	323.0±95.0	0.86
CRP (mg/L)	15.3±15.7	17.0±15.2	11.6±9.9	0.41

*Data are presented as mean ± standard deviation (n/N)

Results

- The study cohort included 28 patients with successful AVF maturation and 16 with AVF failure.
- We annotated 147 metabolites in the pre-surgery plasma samples.
- In patients with successful AVF maturation, 5 metabolites were significantly up-regulated and 4 were down-regulated (p < 0.05, Fig. 1A).
- These significantly regulated metabolites are linked to the metabolism of lipids, amino acids, or starch (Fig. 1B).
- Unsupervised cluster analysis showed that the 9 metabolites could separate AVF maturation success and failure groups (p = 0.002, Fig. 1C).

Metabolite	Fold Change (Success vs Failure)	p-value	Cohen's d (Effect Size)
Docosahexaenoic acid	1.38	0.0001	1.28
Acetylcholine	1.38	0.0017	0.93
3-Hydroxybutyrate	1.28	0.0006	0.78
Lysine	1.53	0.0132	0.74
Urea	1.53	0.0132	0.68
Hydroxybutyrate	0.58	0.0138	-0.72
3-Hydroxybutyrate	0.68	0.0132	-0.72
L-Asparagine	1.48	0.0142	0.54
D-Methionine	0.58	0.0148	-0.68

- Adjustment for clinical and demographic variables did not materially alter the results.
- The metabolites are involved in energy metabolism, tryptophan metabolism, LDL oxidation, and pro-thrombotic pathways.
- If corroborated in larger studies, these metabolites could aid personalized access planning and inform pharmacological intervention strategies.

RRI

Summary

eUBBF enables thrice weekly, cost-free assessment of AVF maturation. In a quality improvement project, this method has been shown to significantly ($P < 0.0001$) reduce catheter residence time after AVF creation.

Metabolomic analysis of pre-surgery plasma samples provides new means to predict AVF maturation outcomes and may open novel pathways to pharmacological interventions to increase AVF maturation rates.