Lunch Talk: Focus on…

Vascular Health and Angiogenesis in Congenital Heart Care

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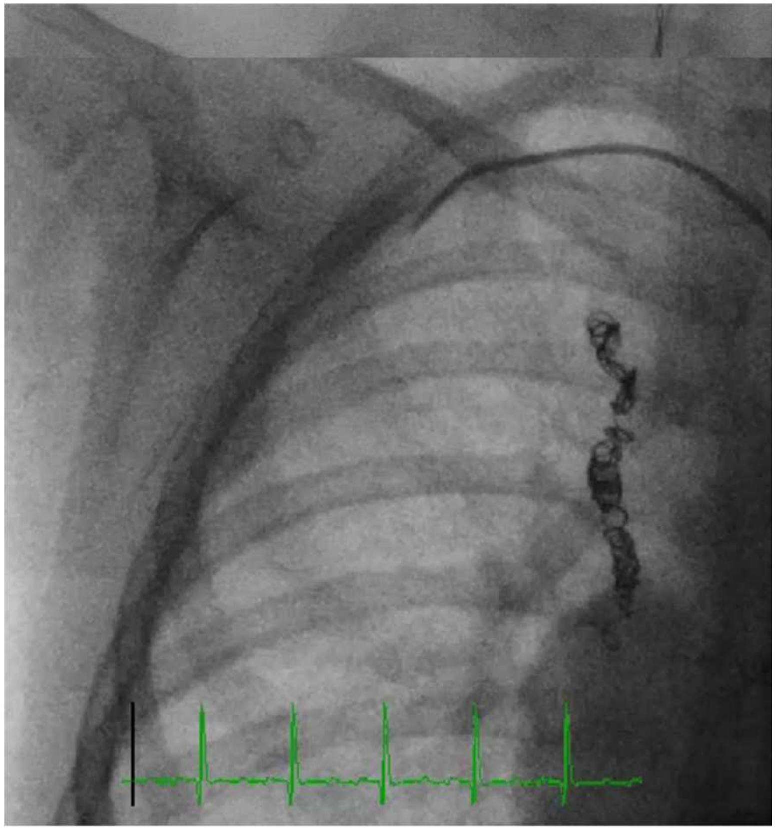
Disclosures

- No relevant disclosures

Case example

- 3 yo PA/IVS, RV hypoplasia
  - Central shunt as neonate
  - Bidirectional Glenn at 5 months
  - Chylous effusions after Glenn
- 7/26/17: pre-Fontan XMR
  - CollF/Ao: 34%
  - Glenn pressure 6-7 mmHg
  - Collaterals embolized



Audience poll #1

- In your practice/center, which patients get a pre-Fontan cath?
  - Almost all
  - Almost none
  - Select patients

Audience poll #2

- In your practice/center, which patients get a pre-Fontan MRI?
  – Almost all
  – Almost none
  – Select patients

Audience poll #3

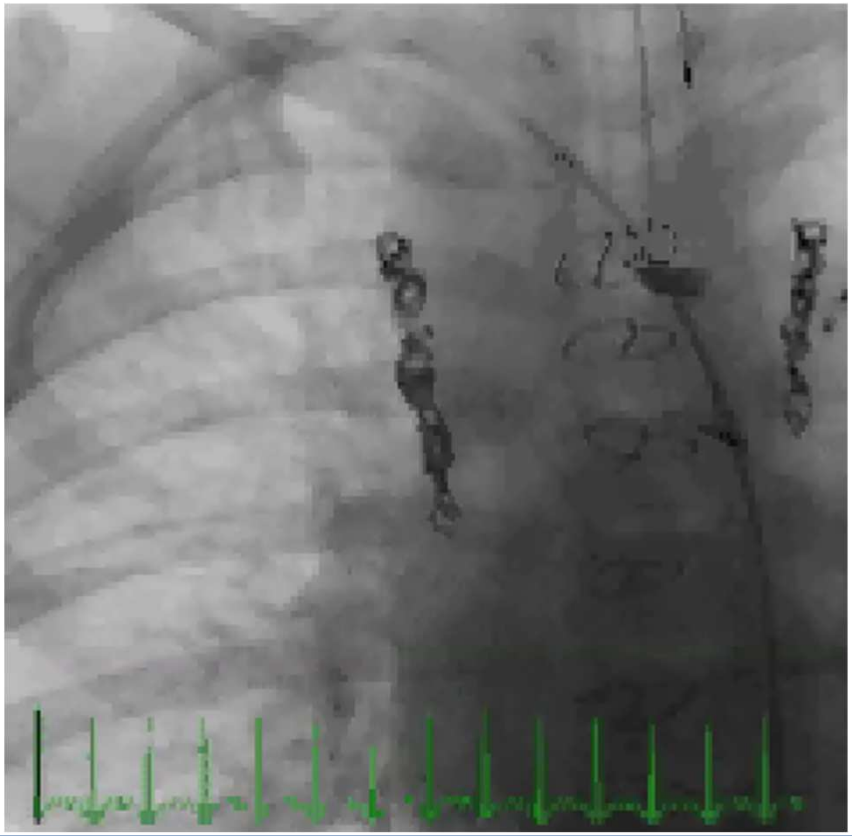
- In your practice/center, for patients who get a pre-Fontan cath, collateral embolization is performed…
  - In almost all
  - In almost none
  - In select patients

Case example (cont.)

- 8/9/17: fenestrated extra-cardiac Fontan
  - 7 days of chest tube
  - 14 days total length of stay
- 1/20/18: readmitted with large right pleural effusion
  - Coronavirus, RSV positive
  - Chest tube placed → chyle
  - Increased diuretics, low fat diet, started sildenafil
  - 2/7/18: cardiac cath…

Case example (cont.)

- Cardiac cath
  - High fontan pressures
  - LPA stenosis
  - Open fenestration
  - Collaterals embolized
  - LPA stented



Case example (cont.)

- Chest drainage slowed a few days after cath then stopped
- Chest tube pulled
- Discharged 7 days after cath

What do we know about collaterals in single ventricle patients?

Collaterals in 1V patients

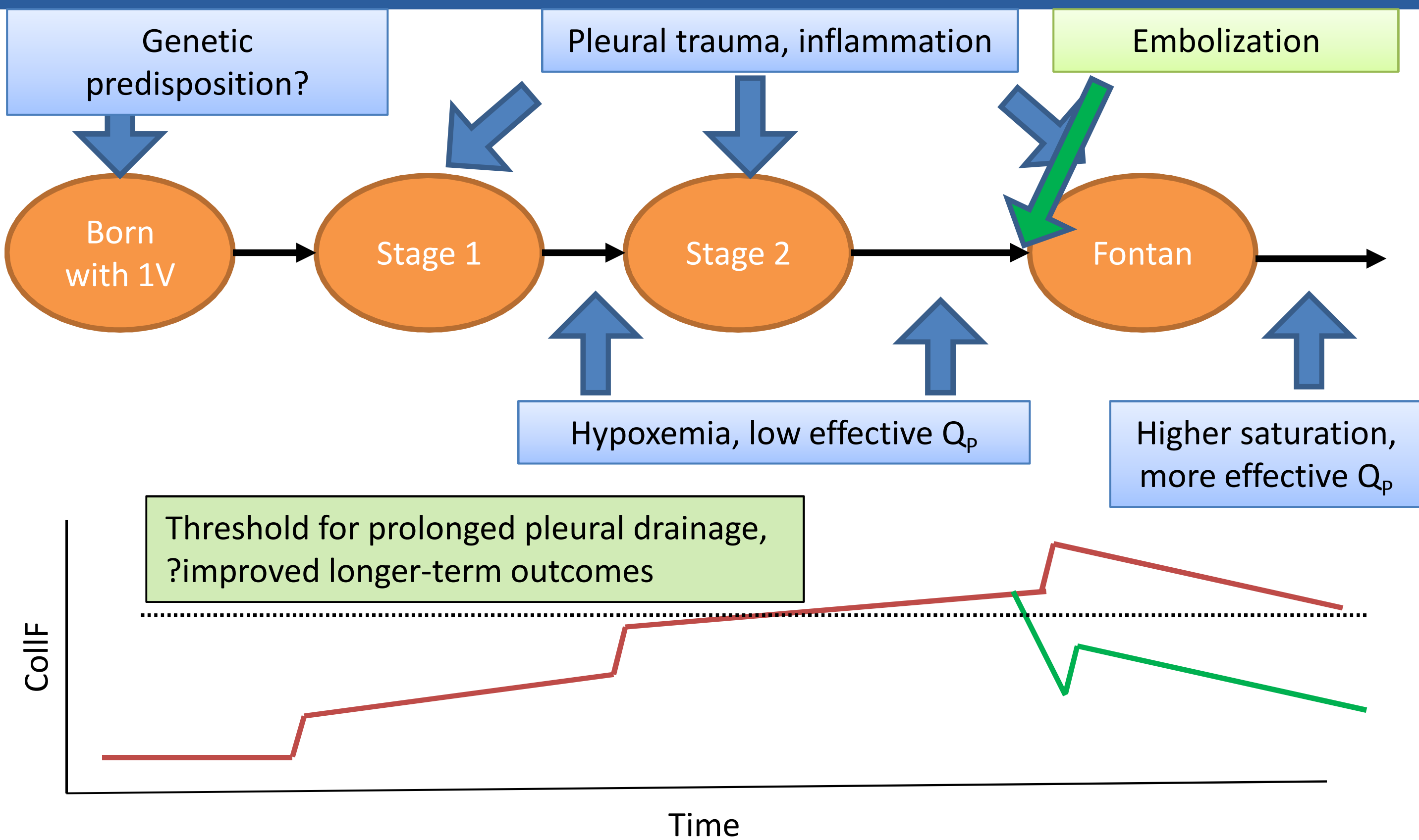
- Quantifiable by cardiac MRI (Whitehead, *Circ CV Imaging*, 2009)
- Ubiquitous (Whitehead, *Am J Cardiol*, 2015)
- Related to preceding cyanosis, peri-operative morbidity, and pleural inflammation (Glatz, *Heart*, 2015)
- Hemodynamically important (Downing, *Circ CV Imaging*, 2013)
- Associated with acute post-Fontan clinical outcomes (Glatz, Circ CV Imaging, 2012)
- Regress after the Fontan (Whitehead, *Am J Cardiol*, 2015)

What do we know about the efficacy of collateral embolization in the cath lab?

Collateral embolization

- Acutely efficacious (Dori, Circ CV Interv, 2013)
- Durability is not known
- Effects on post-Fontan course are not known
- There is a lot of practice variation
- It is, at best, a band-aid

Conceptual Model

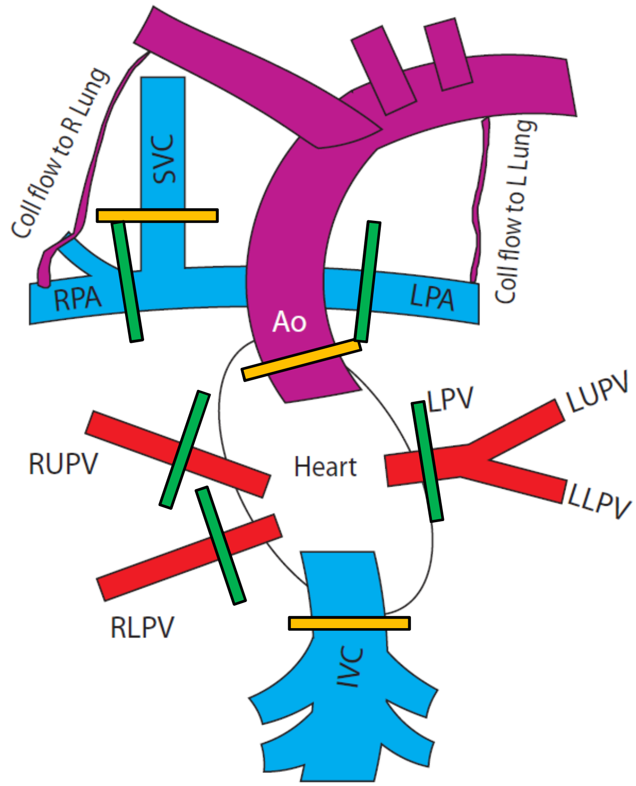


Our approach to the pre-Fontan

- XMR
- If MRI shows something concerning, proceed to cath
- Aggressive embolization during cath using particles and coils
- Fontan completion within 2 weeks

Thank you

Stage 2 physiology



$$\mathbf{Q_{coll\_syst}} = Q_{Ao} - (Q_{SVC} + Q_{IVC})$$

$$\mathbf{Q_{coll\_pulm}} = (Q_{RPV} + Q_{LPV}) - (Q_{RPA} + Q_{LPA})$$

$$\mathbf{Q_{coll}} = (Q_{coll\_syst} + Q_{coll\_pulm}) / 2$$

Results, cross-sectional data

	SCPC	TCPC	p (SCPC vs. TCPC)	Controls	p (SCPC vs. Ctrl)	p (TCPC vs. Ctrl)
n	115	135		18		
Age (years)	2.6±1.2	12.2±8.8	<0.001	10.1±7.4	<0.001	1.0
BSA (m^2)	0.53±0.10	1.16±0.51	<0.001	1.05±0.49	<0.001	1.0
Q_{Ao} (L/min/m^2)	4.85±1.1	3.61±1.0	<0.001	3.9±0.9	0.007	1.0
Q_{coll} (L/min/m^2)	1.64±0.8	1.03±0.8	<0.001	0.21±0.27	<0.001	<0.001
$100xQ_{coll}/Q_{Ao}$ (%)	34%±12%	26%±15%	<0.001	5%±6%	<0.001	<0.001
$100xQ_{coll}/Q_P$ (%)	48%±17%	29%±17%	<0.001	5%±5%	<0.001	<0.001
Q_P (L/min/m^2)	3.4±0.9	3.3±0.8	1.0	4.1±1.0	0.006	0.005
Q_S (L/min/m^2)	3.2±0.9	2.6±0.6	<0.001	3.7±0.8	0.11	<0.001
Q_{PA} (L/min/m^2)	1.7±0.6	2.3±0.6	<0.001	3.9±0.9	<0.001	<0.001
Q_P / Q_S	1.10±0.3	1.31±0.40	<0.001	1.13±0.2	1.0	0.20

Results, Glenn patients (n=96)

Table 2a. Correlation between potential risk factors and CollF measures						
Risk factor	CollF		CollF / Ao flow		CollF / PV flow	
	rho	p	rho	p	rho	p
Total ventilator days	0.24	**0.03**	0.29	**0.008**	0.37	**0.0007**
Total ICU days	0.23	**0.04**	0.29	**0.008**	0.39	**0.0003**
Total hospital days	0.25	**0.02**	0.33	**0.002**	0.39	**0.0003**
Total chest tube days	0.21	**0.04**	0.24	**0.02**	0.2	**0.05**
O_2 sat at Stage 2 discharge	0.22	**0.04**	0.19	*0.06*	0.06	0.57

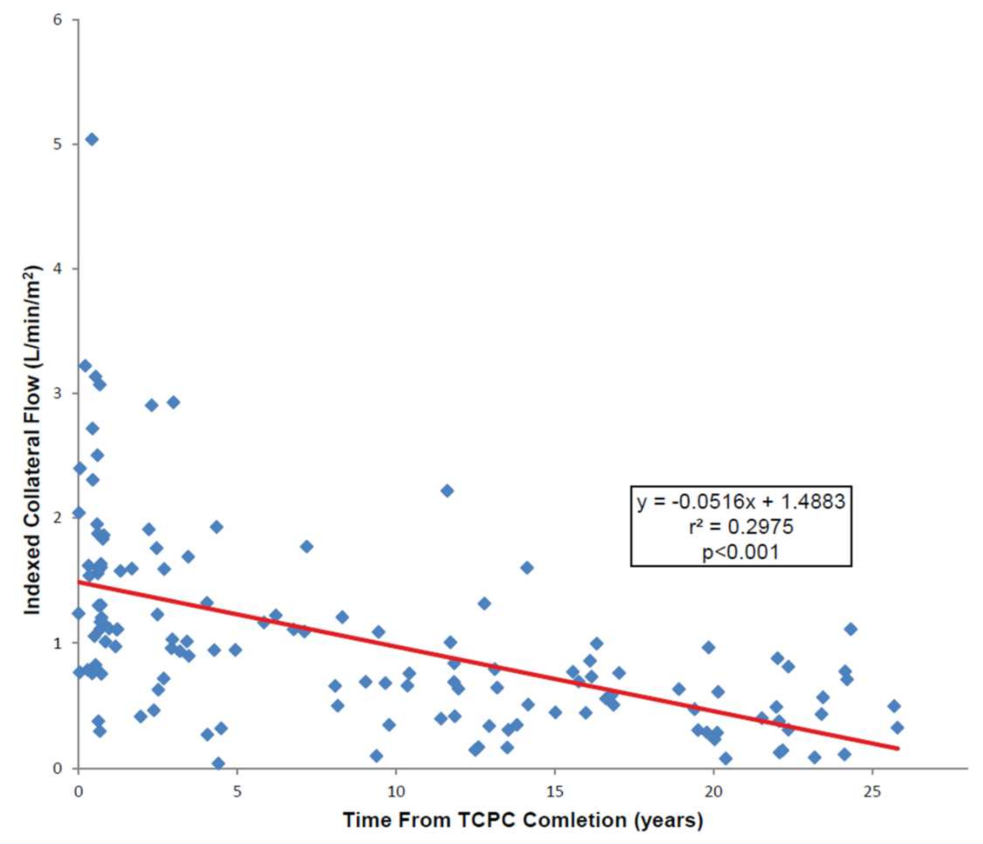
- No associations found with hemoglobin, pulmonary artery size, pre-Stage 2 cath variables, or Stage 2 surgical support times.

Estimates of effect size

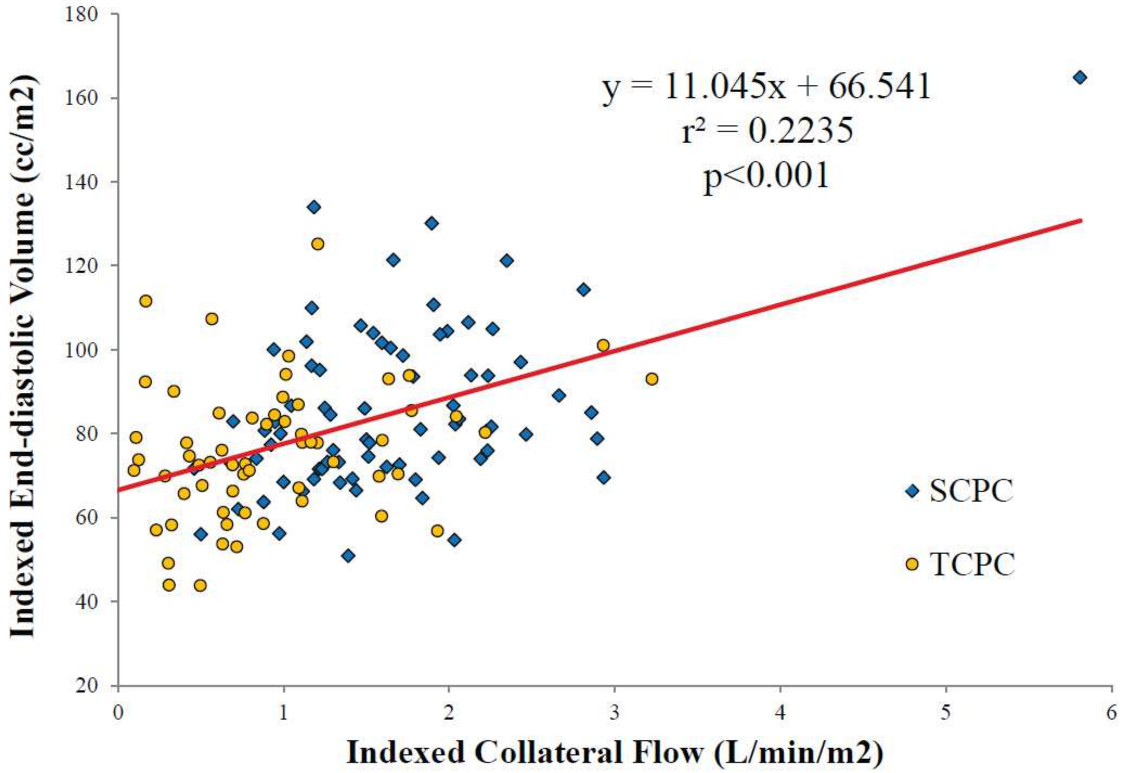
	Chest tube ≥ 10d		Hospitalization ≥ 7d		Hospitalization ≥ 14d	
	OR*	p	OR*	p	OR*	p
Q_{coll}	22.7 (2.2,239)	**0.009**	9.2 (1.4,61)	**0.02**	1.46 (0.6,3.3)	0.4
Q_{coll}/Q_{Ao}	1.24 (1.06,1.4)	**0.007**	1.09 (1,1.2)	**0.048**	1.06 (0.99,1.14)	0.1
Q_{coll}/Q_{PV}	1.18 (1.05,1.34)	**0.006**	1.07 (1,1.14)	**0.048**	1.04 (0.98,1.09)	0.17

*From logistic regression, adjusted for presence of a fenestration and Fontan type (extra-cardiac conduit v. intra-atrial lateral tunnel); Q_{coll} = systemic-pulmonary collateral flow; Q_{Ao} = aortic flow; Q_{PV} = pulmonary venous flow

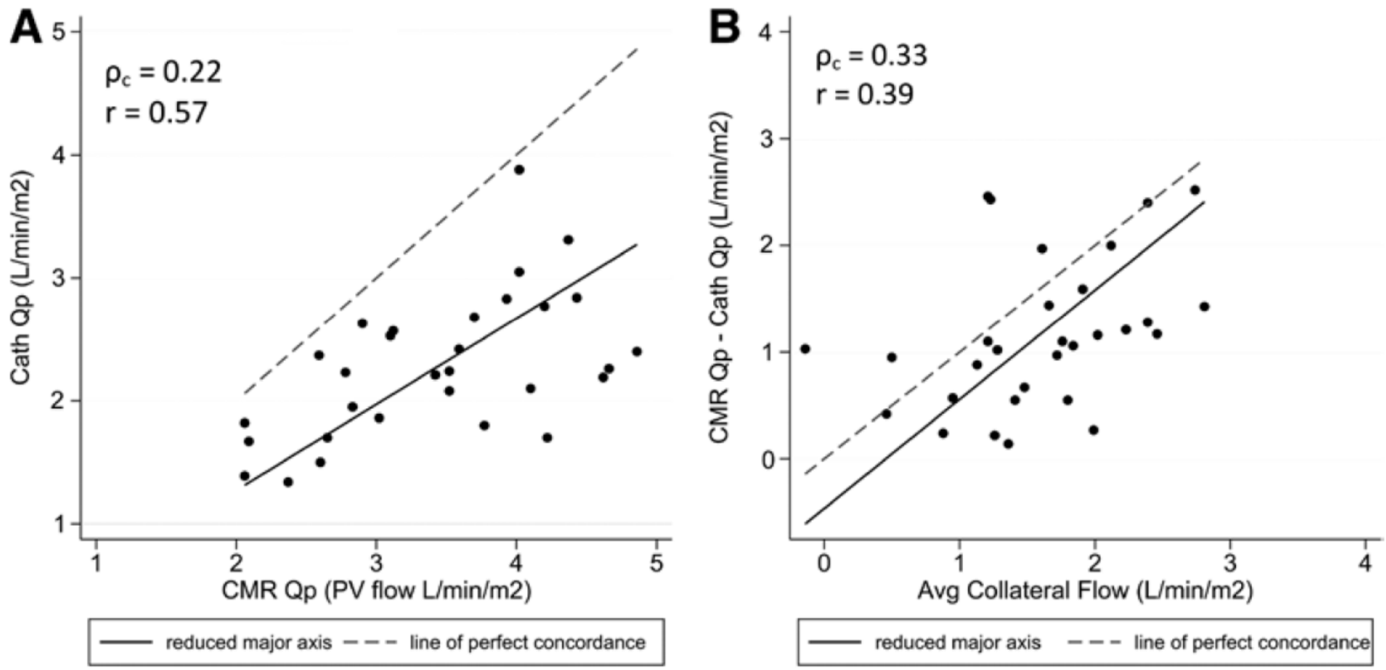
“Natural” history late after Fontan



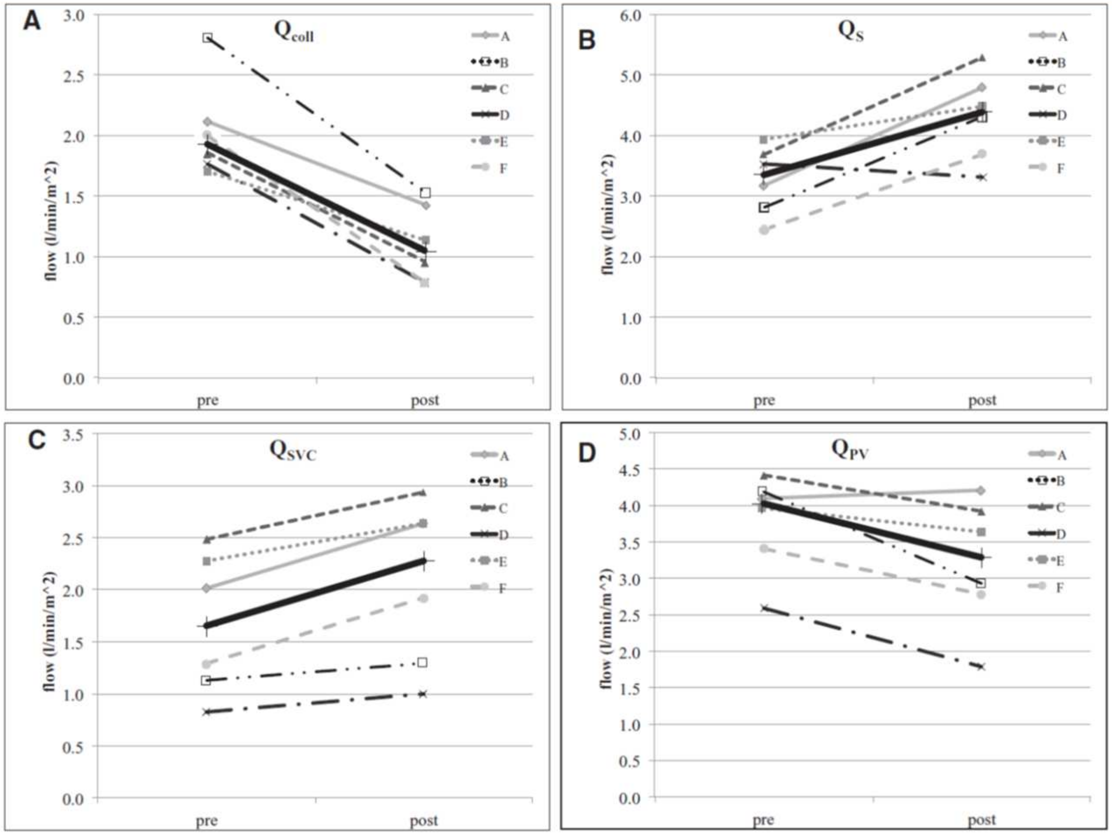
Collaterals as a volume load



Cath underestimates Q_P



Acute efficacy of embolization



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