How to approach the problem of clinical relevance of a SB: Analytical perspective

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Introduction

Side branch (SB): To treat or no treat?

Identification of coronary artery side branch (SB) supplying myocardial mass that may benefit from revascularization (Kim et al, JACC Intv 10: 571-81, 2017)...Revascularization could be identified by SB length $\geq$ 73 mm.

Why length, diameter, etc. Ultimately, myocardial mass is what matters?!

Design of Coronary Tree

"Physiological organization, like gravitation, is a "stubborn fact," and it is one task of theoretical physiology to find quantitative laws which describe organization in its various aspects."

Cecil D. Murray, 1926
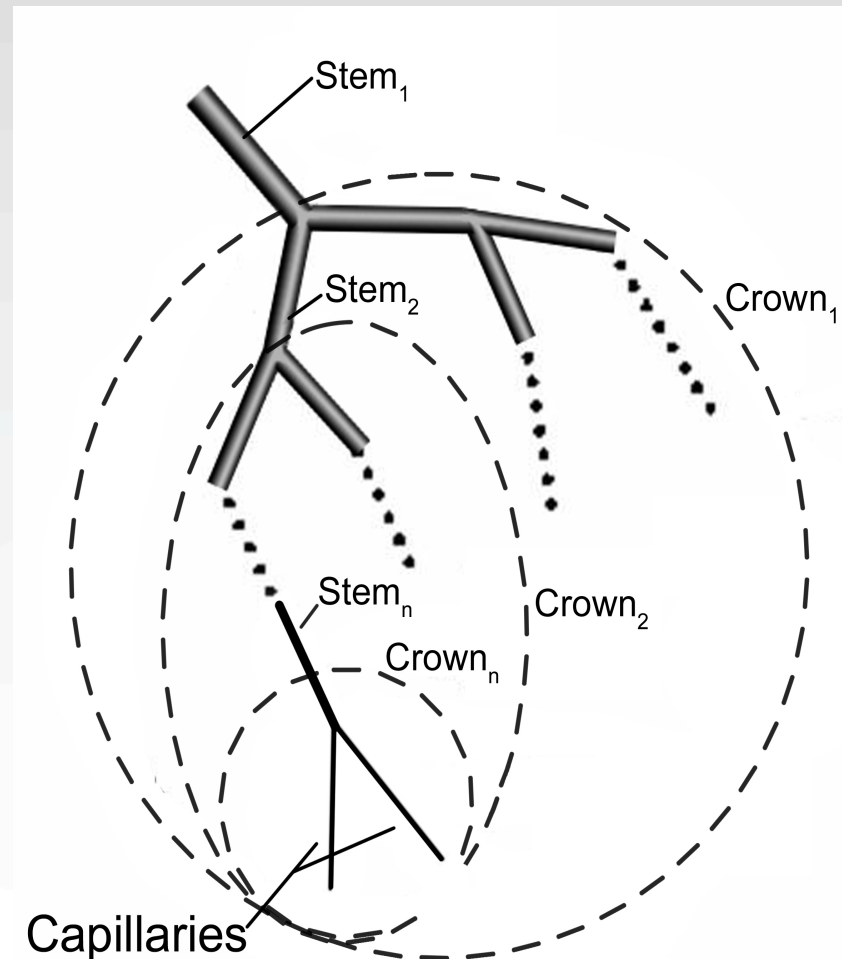
Scaling Laws of Design

$V_c \; \alpha \; D_s^3$

$Q_s \; \alpha \; L_c$

$D_s \; \alpha \; L_c^{3/7}$

$Q_s \; \alpha \; D_s^{7/3}$ (Murray's Law: $Q_s \alpha \; D_s^3$)

$Q_s \; \alpha \; V_c^{7/9}$

D_s, Q_s – Diameter and flow of **stem**

V_c and L_c – Volume and length of **crown**

J. Royal Society Interface, 7;9(66):190-200, 2012.

Relation to Myocardial Mass
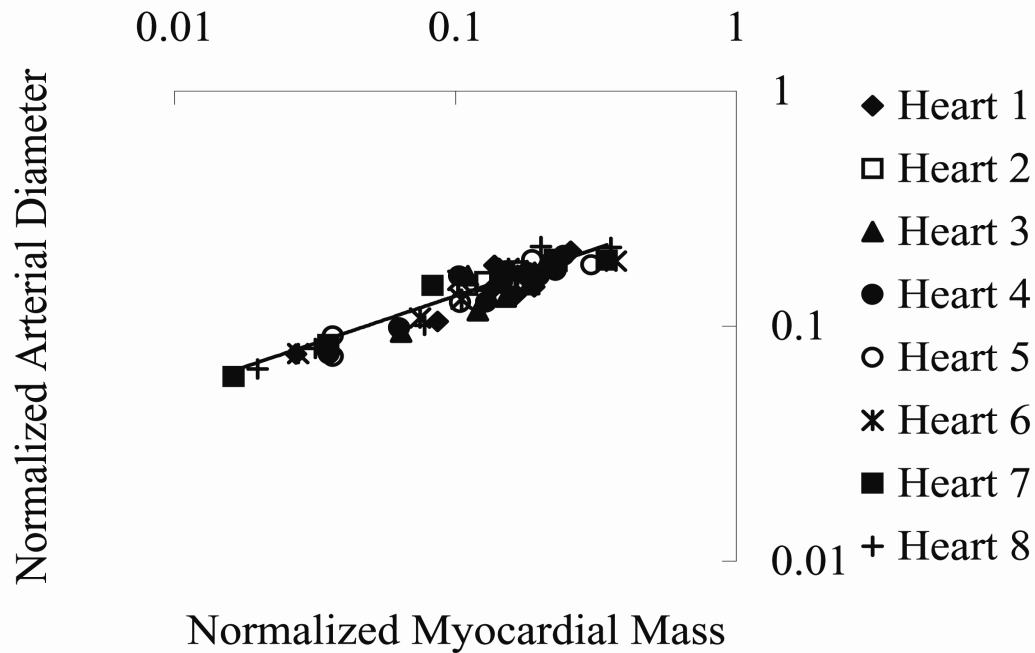
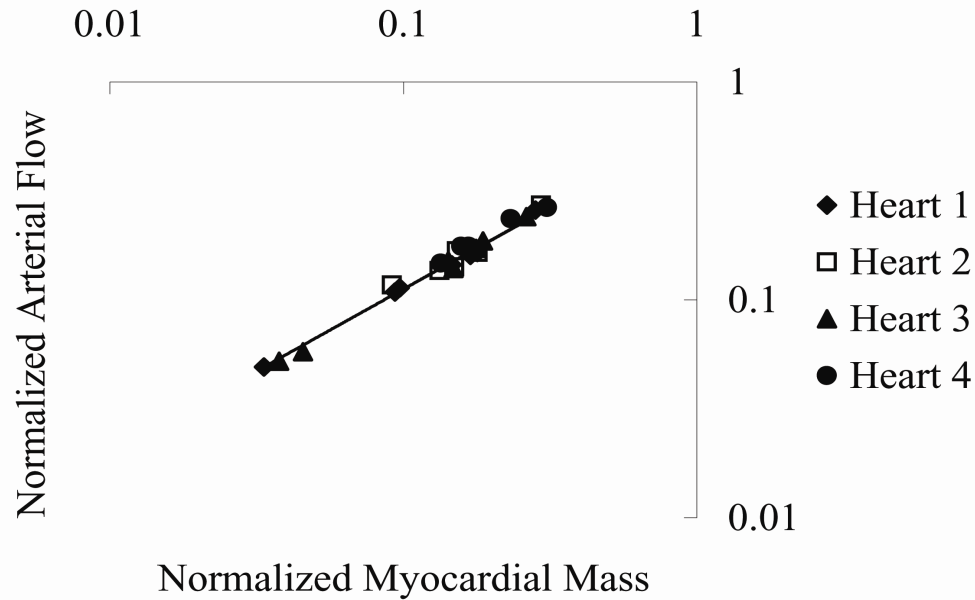# Vascular Volume – Myocardial Mass
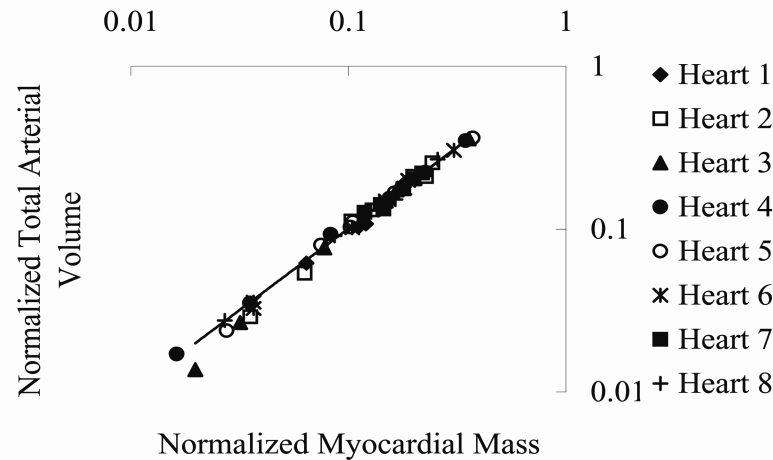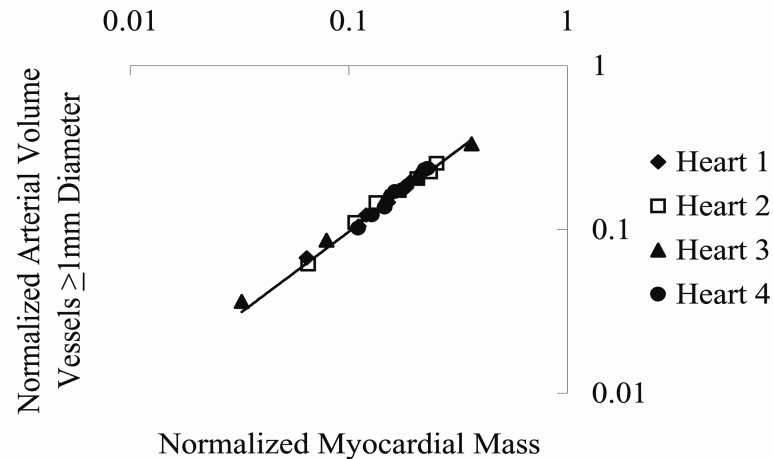
Cumulative Length – Myocardial Mass
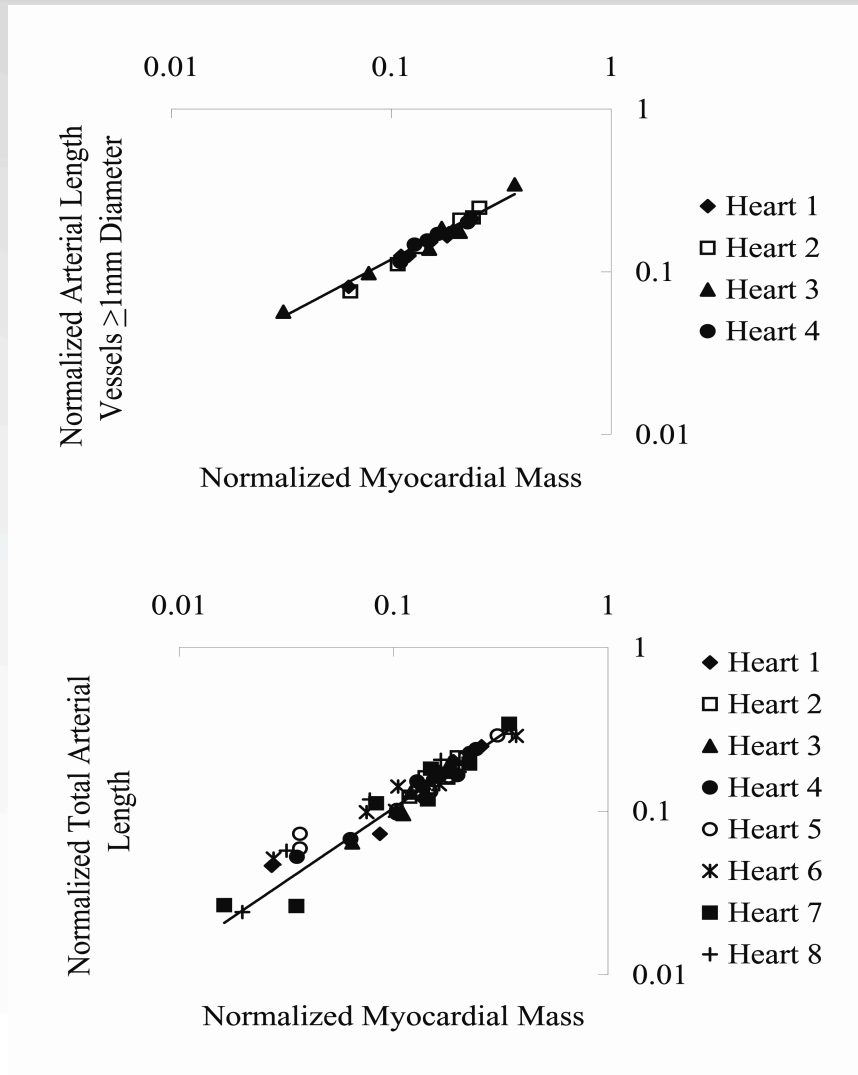
Stem Diameter - Myocardial Mass

Stem Flow - Myocardial Mass

Myocardial Mass Scaling Laws

$$M \propto V_c$$

$$M \propto L_c^{4/3}$$

$$M \propto D_s^{8/3}$$

$$M \propto Q_s^{4/3}$$

M – Mass; V_c and L_c – Crown volume and length; D_s and Q_s – Stem diameter and flow

J. Appl. Physiol., 104(5):1281-6, 2008.

Rationale for SB Revascularization Criterion

L_c as per Kim et al, 2017: $Q_s \propto L_c$ and $M_s \propto L_c^{4/3}$

New hypothesis:

V_c since $M \propto V_c$ and $Q_s \propto V_c^{7/9}$

$V_s \propto L_c^{9/7}$ can be measured angiographically either in terms of L_c or V_s