The constant volume heart: an old hypothesis finally confirmed in a very old mollusc

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J. A. R. Ramsay (c.1950): The constant volume heart model:

The gastropod heart + pericardium maintains a constant net volume throughout the cardiac cycle

Studied (and confirmed) here in a gastropod morphologically conserved over evolutionary time

Norman’s interpretation:
Learn to use the limited resources nature has given to you
Lean Design 101:

Building a circulatory system from one muscle
How does this work in practice?

Step 1. Learn the vascular geography of the abalone (*H. iris* in this case)
Step 2. Shell preparation
Step 3. Insert cannulae attached to pressure transducers
Mean circulatory filling pressure.
OK... so it’s a constant volume heart... why is that useful for the abalone?
A catheter is fitted to the paua and a weakly radioactive marker injected: either $^{51}$Cr-EDTA or $^{14}$C-Inulin.

Blood is sampled every 2h to allow the marker to mix thoroughly, the data are corrected for clearance and the instantaneous volume of distribution is calculated.

More than half of the tissue (55.4%) is blood – equivalent to 42% of live weight.
The constant volume principle is confirmed in the heart of *Haliotis iris*. The resulting pericardial pressure transfer allows a single ventricular muscle to simultaneously support aortic flow, gill perfusion and left kidney filtration.